NCRPIS ANNUAL REPORT - 2010

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NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION
NC-7 ANNUAL REPORT, JANUARY 1 - DECEMBER 31, 2010

I. PROJECT TITLE:

NC-7 "Plant Germplasm and Information Management and Utilization"

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS (current):

A. Administrative Advisor

*W. Wintersteen, Iowa

B. Regional Coordinator

*C. Gardner, ARS, Iowa

C. State Experiment Stations Representatives

Voting members

1. Illinois	G. Kling	7. Missouri	J. Shannon
2. Indiana	J. Janick	8. Nebraska	D. Santra
3. Iowa	R. Hall	9. N. Dakota	B. Johnson
4. Kansas	M. Stamm	10. Ohio	D. Francis
5. Michigan	A. Iezzoni	11. S. Dakota	K. Glover
6. Minnesota	J. Orf	12. Wisconsin	W. Tracy

Non-voting participants

13. California-Davis	R. Karban	19. New Jersey	S. Handel
14. Connecticut	M. Brand	20. New Jersey	T. Molnar
15. Iowa	K. Lamkey	21. New York	M. Smith
16. Kansas	A. Fritz	22. Texas	D. Baltensperger
17. Michigan	J. Hancock	23. Wisconsin	S. Kaeppler
18. Missouri	S. Flint Garcia	24. Wisconsin	N. de Leon

D. U. S. Department of Agriculture

1. ARS National Program Staff, Plant Germplasm	*P. Bretting
2. ARS Plant Exchange Office	*E. Garvey
3. ARS Area Director, Midwest Area	L. Chandler
4. Cooperative State Research, Education and Extension Service	A. Thro
5. National Center for Agric. Util. Research	*T. Isbell
6. National Center for Genetic Resources Preservation	*D. Dierig

*Voting members

E. North Central Regional Plant Introduction Station, Ames, Iowa

See organizational chart, Figure 1 in the Appendix.

III. PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Personnel changes - June, 2010– May, 2011:
Departures:
Bruce Hall, USDA-ARS Agricultural Research Science Technician, January, 2011
Matthew Lively, USDA-ARS Agricultural Research Science Technician, May, 2011
Luping Qu, USDA-ARS Horticulturist, Medicinal Plants, May, 2011

New Hires:
Ashley Hall, Agricultural Research Science Technician, Maize, January, 2011

Promotions:
Jesse Perrett, student Computer Assistant, to a Student Trainee IT Specialist for Systems Administration, December, 2010

Management of Federal STEP (Student Temporary Employees):
USDA-ARS resources provided for 17 student labor or temporary positions in FY10-11. We limited equipment purchases, postponed recovering a greenhouse for a third year and focused on increasing the availability of the collections and quality of associated information. The STEP positions support curatorial activities including regeneration, seed processing, viability testing, farm and facilities operations, and IT support. Students were interviewed and selected by ISU Program Manager Larry Lockhart or ARS technicians Matt Lively and Irvin Larsen. Marci Bushman and Rachael Beyer managed the administrative aspects of all STEP hires, with support and guidance by Ames ARS HR Specialist Kim Grandon and Admin. Officer Carol Moran.

Budget:
Declining purchasing power of budgets and rising salary, energy and operational expenses continue to erode our ability to support core functions. The ARS CRIS project was funded at $ 2,258,002 in FY10, of which 85% was devoted to salaries and wages. In FY11, personnel costs make up 92% of the $2,158,781 allocated funding, prior to rescissions. Further reductions in funding will force a reduction in student hiring, necessary for executing our genebank's mission. In FY09-11, Hatch funds ($522,980) were devoted to the salaries of our ISU staff and expenses.

These funds were supplemented by a component of a USDA/DOE grant evaluating *Helianthus argophyllus* for biomass potential on which Oilseeds Curator Dr. Laura Marek serves as a co-PI with PI Steve Knapp, Univ. of Georgia; it provided for one full-time equivalent ISU student employee and a portion of Dr. Marek's compensation.

The ARS PIRU Unit's medicinal curator position and a student position are supported 50% by ARS Horticulturist Dr. Mark Widrlechner's NIH research grant sub-contract on Botanical and Dietary Supplements through May of 2011, for which he serves as co-PI with Dr. Diane Birt of Iowa State University. The NIH grant also provided for 0.5 STEP in the first half of FY11.

Dr. Charles Block's Sclerotinia Initiative funding supports student labor and supplies used in that research. GRIN-Global grant funds supported the salaries of contract development personnel, ARS personnel overtime, and project-related travel of one ARS staff member through December, 2010 .

Construction and Facilities:
Field waterways were reshaped, and in one field a drainage tile intake was installed. The framework and the Kool-Cel units of the Entomology Greenhouse were replaced; the vertical elements of the framework were completely corroded at their base. The Horticulture technician's office was remodeled, using excess furniture from the National Animal Disease Center. In FY11, we plan to recover Greenhouse #3.

Equipment:
Major purchases include 195 7×7×20 cage frames and 135 sunflower cage frames to replace those damaged in a severe storm (this item funded by the USDA-ARS Office of National Programs) and a Regi Weeder to assist in small plot weed control.

IV. PROGRESS IN GERMPLASM AND INFORMATION MANAGEMENT, RESEARCH, AND EDUCATION (C. GARDNER):

(Part IV. summarizes the accomplishments and progress presented in greater detail in the individual staff reports in the document.)

Acquisition and Documentation Highlights:
In 2010, (Appendix Table 1) 516 new accessions were acquired, equal to 1.0% of the previous collection holdings. Of these, 332 were received from within the NPGS through exploration and transfer. This compared with 521 new accessions in 2009, 564 in 2008, and 450 in 2007. Newly acquired germplasm included) 70 accessions of ornamentals primarily *Fraxinus* and mints; 115 oilseed accessions including 67 accessions of cultivated *Helianthus* from the Northern Crop Science Laboratory in Fargo, ND and 33 from the National Center for Genetic Resources Preservation (NCGRP), and 56 accessions of wild *Helianthus*; two species that new to the collection, *Amaranthus torreyi* and *A.* ×*tucsonensis*; wild populations of *Aronia* and of *Gymnocladus* (Kentucky coffeetree); 178 maize accessions including 46 expired Plant Variety Protected (PVP) accessions, 16 GEM releases, and 16 inbred lines donated by Dr. John Doebley of the University of Wisconsin; 45 new accessions of *Daucus* collected in Arizona, California, New Mexico, Oregon, and Washington by Drs. David Spooner and Philipp Simon.

Of ongoing concern is the successful entry of germplasm collected from international explorations into the U.S. It is critical that clean, pest- and pathogen-free seed be shipped or carried in by collectors; sufficient time needs to be devoted to collection sample preparation and sufficient care post-collection. Excellent quantities of seed provided by collectors of many new accessions have made a significant proportion available and distributable immediately.

Fifty four accessions were assigned permanent PI numbers in 2009. Taxonomic re-identification was completed for 147 accessions; 26 accessions were nominated for inactivation. R. Stebbins continues to enter old passport information from logbooks for early Ames-numbered accessions.

Original seed samples continue to be scanned by L. Pfiffner and L. Burke, in order to provide useful visual references for comparison of regeneration lots with original samples.

Regeneration and Maintenance Highlights:
In 2010, 1,203 accessions were grown for regeneration and 1,170 were harvested, as compared to 1,096 accessions grown for regeneration and 1,017 harvested in 2008. An additional 160 perennials are growing in permanent plantings. About1,035 accessions were made available to the public. Accessions backed up at the NCGRP in Ft. Collins in 2010 numbered 2,388, compared with 1,848 in 2009. Seventy-nine percent of the NCRPIS collections are backed up (Appendix Table 2), unchanged from 2009. Overall collection availability is 74% (unchanged), despite 4% growth in collection size since 2006. An additional 1,936 accessions were sent to Ft. Collins for assembly with accessions from other NPGS sites and deposit to the Svalbard Global Germplasm Vault.

The Entomology staff continued use of an application designed in-house, Pocket Pollinator, to gather information on pollinator insect actions connected with regeneration efforts and store it in the GRIN database. Over time, this will provide a rich database that can be explored to better understand effective plant-pollinator interactions with respect to seed production.

Assistance in regeneration was provided by USDA-ARS staff of Parlier, CA for increase of wild *Helianthus* taxa. *Daucus* regeneration efforts were supported by seed increases from Seminis Vegetable Seeds (R. Maxwell) and Nunhems (R. Freeman). Maize regeneration and observation assistance for 250 tropical maize populations was provided by Monsanto (D. Butruille) in Hawaii. T. Foley regenerated 14 expired maize PVPs at various locations. USDA-ARS staff of Mayaguez, PR and the St. Croix quarantine nursery staff supported regeneration of 36 maize accessions. GEM Project Coordinator Michael Blanco provided resources in Puerto Rico to increase 5 tropical inbreds, as the maize curation project did not have the resources for a winter nursery in 2010. Matt Krakowsky, USDA-ARS, Raleigh, NC, increased 11 late inbred sub-tropical and tropical lines.

Spinach regenerations were supported by cooperative efforts between the USDA-ARS and Sakata Seed America, Inc. in Salinas, CA.

Distribution:
2010 external distributions included 26,651 items of 13,226 unique accessions to fulfill 1,279 orders from 943 requestors. This compares with 2009 distributions of 26,904 items of 13,515 unique accessions to fulfill 1,487 orders from 1,081 requestors. Approximately 28% were distributed internationally and 72% to domestic researchers (Appendix Table 3A). A detailed listing of distributions by site crop can be found in Appendix Table 5. The relative numbers of distributions

generally correlate well with the proportional makeup of the collections and vary from year to year, although demand for maize demand is always larger than for other crops. An additional 8,649 items were distributed within the NCRPIS for all internal genebank activities (Appendix Table 3B).

Curator	Collection Size 2010	% of Total Collections	% of 2010 Distributions	% of 2009 Distributions
Brenner	8954	17	12	12
Marek	11403	22	23	16
Qu	494	1	1	<1
Millard	20383	40	44	43
Reitsma	7587	15	19	25
Widrlechner	2572	5	1	3
Totals	**51,393**	**100**	**100**	**100**

Research demand for our plant genetic resources collections continues to be very high; requests for biofuel applications and health and nutrition contribute increasingly to these increases, as well as for basic research applications, disease and insect resistance, photoperiod response, and an array of performance traits. Demand for *Zea mays*, *Helianthus*, Brassicaceae, and *Daucus* for evaluation and characterization were particularly high.

NPGS curators at all sites continue to receive many requests from individuals not affiliated with research institutions, generally for home gardening. Home gardeners are redirected to other sources of commercially available materials. Although our resources cannot support maintaining and distributing the collections to home gardeners, we inform these requestors about plant genetic resource conservation, and encourage interested individuals to save seeds, conserve them, and share germplasm and associated information. The proliferation of websites instructing non-research requestors how to deceive curators at various germplasm sites in order to get free germplasm continues to be problematic. The careful efforts that go into each and every increase, characterization, imaging, processing, storage, viability testing, and distribution surely make these seeds among the most expensive to provide in the world.

Evaluation and Characterization:
In 2009, the NCRPIS utilized 7,406 accessions for internal observation, evaluation and characterization for a wide array of descriptor information, viability testing, etc. (Appendix Table 3B). About 2,000 of these were for the maize inbred phenotyping / genotyping effort. About 17,720 observations were entered in the GRIN database (http://www.ars.grin.gov/npgs/), more than the 15,700 observations entered in 2009, but much less the amount in 2008.

Images added to GRIN for the year number 1,482 (Appendix Table 4), nearly triple that of 2009.

A collaborative project to evaluate outcrossing of grain amaranth cultivars with weedy amaranth species is in progress.

Information technology and telecommunications:
The NCRPIS staff provides expertise and leadership for the development of GRIN-Global (the successor to the GRIN system); this has become the primary focus of two NCRPIS staff members. This project is undertaken as a partnership between USDA-ARS, Bioversity International and the Global Crop Diversity Trust (the Trust) to develop a genebank information management system which can be deployed to any genebank in the world. National Program 301 Leader, Peter Bretting is the PI for this agreement.

The basic GRIN database schema is recognized as essential to preserve; improved interfaces and views are required to support the needs of genebank curatorial personnel and external, public users of information associated with the collections. The source code for the products of development will be freely available. The system will be able to function on either networked systems or stand-alone PCs, and will be free of recurring licensing costs.

Ames-based development team members include Pete Cyr, our Applications Software Development IT Specialist, Project Manager; Mark Millard, Maize Curator, Analyst; Lisa Burke, Seed Storage Manager, beta tester; and Candice Gardner, RL and occasional beta tester. Other key ARS team personnel involved in development include the staff of the Database Management Unit in Beltsville, MD. ARS personnel from the National Clonal Germplasm Repository in Corvallis, OR, and the Miami Sub-Tropical Research Station. FL, provide valuable input representing the needs of the clonal germplasm community. Together with our international partners, we work to accomplish ambitious project objectives within tight timelines. U.S. curators and Bioversity International personnel tested a GRIN-Global System release candidate (RC 2) in 4th quarter of 2010. International deployment is anticipated in 2011, and U.S. NPGS deployment approximately a year later.

Please see IT section for technically detailed reports on support activities.

Germplasm's Viability and Health:
Over 2,570, or 5% of the NCRPIS collections, were tested for viability in 2010, similar to 2009 levels due to labor constraints (Appendix Table 2). Results of experimental viability testing methods to release seed dormancy in *Echinochloa* were published. The progress of after-ripening in *Calendula* was documented in order to better understand loss of seed dormancy in cold storage over time. Alternative treatments to six week cold-stratification treatments were explored for breaking seed dormancy of wild *Helianthus*. Use of a thermal gradient table has enabled D. Kovach to conduct a series of experiments comparing controlled temperature, light and humidity conditions to establish appropriate seed germination testing protocols for various crops. The technology also has been used by graduate student Ivan Ayala Diaz in his studies of *Thlaspi* and *Camelina*. Mr. Ayala is also evaluating stand establishment of pennycress under different planting-depth regimens.

Pathology team research (C. Block) focused on combining greenhouse and field resistance screening methods for Sclerotinia stalk rot in wild sunflowers; long-term survival and seed transmission of bacterial fruit blotch (*Acidovorax avenae* subsp.

citrulli), or BFB, in Cucurbits with an emphasis on identifying infected, older *Cucumis melo* seedlots; screening of all *Cucumis* seedlings grown for presence of Squash Mosaic Virus via ELISA; regular disease monitoring of cucurbit plantings from transplant to harvest; screening of maize for Stewart's wilt resistance and northern corn leaf blight; and testing maize inbreds of known Stewart's wilt response for Goss's wilt resistance. Field observations were made in the increase plots, and accessions were monitored in particular for diseases for which seedborne transmission is of concern.

Insect management:
Entomologists S. Hanlin and S. McClurg supplied 626 accessions in 269 cages with five types of pollinator insects in 2010. Detailed, interesting observations and interpretative information regarding their field pollinator research activities can be found in their extensive section of the annual report for information on their continuing efforts to enhance the pollination program's effectiveness and efficiency., Substantial report space is devoted to this team's activities because of the uniqueness of this project, limited sources of such information, and relevance to the broader germplasm conservation world. Feedback and suggestions on experimental approaches are welcomed.

The staff continues to compare use of solid 'fondant' sugar with corn syrup for feeding the honey bees. While fondant sugar use decreases labor needs, honeybees cannot store this sugar as a resource for winter. During the summer months, food source did not impact nucleus hive strength. It is necessary to use corn syrup feed in the early spring to dispense medication and in the late summer to enable the bees to build honey stores for overwinter survival.

We continue to consider the impact of the effectiveness of insect pollinators on cross-fertilization of caged plantings, and whether the genetic profile of the accession is maintained during regeneration. Resources will determine to what extent we can devote focused future studies to this question, and will require careful selection of parent lots and assay of their progeny using molecular markers or known discernible traits.

Enhancement:
The Germplasm Enhancement of Maize Project, or GEM, continues to work with public and private collaborators to adapt exotic maize germplasm to broaden the genetic diversity of temperate U.S. maize production and provide unique, key priority traits. Research and breeding are designed to improve exotic germplasm introgression methods, to provide unique sources of allelic diversity, and to identify traits and genes to support improvement of agronomic productivity, disease resistance, insect resistance, and value-added grain characteristics, including total extractable starch to support ethanol production, and resistant starch – of importance to human health and nutrition.

The Ames and Raleigh, NC GEM Projects have released 214 lines from 2001-2010, representing over 40 maize races. An important goal is development of a set of inbred lines representative of the diversity inherent to all of the races of maize. In addition to traditional introgression methods, the project is using a haploid inducer

line and generating doubled-haploid maize lines. With the collaboration of AgReliant and Monsanto, 2010-produced initial doubled-haploid seeds were increased in Hawaii and Chile winter nurseries. The ISU Doubled Haploid Facility is an important partner in this effort.

Photoperiod sensitive tropical maize often does not flower until September in Ames. GEM and maize curation teams have continued to collaboratively develop an effective method for photoperiod control in the field. While successful, it is difficult to achieve the field scale needed to support the number of accessions that require photoperiod control treatment. This effort has been leveraged by the sunflower project, which has used it very effectively to induce flowering in certain wild sunflower accessions. Photoperiod-control environment capacity on the order of one to three acres would be very useful in maintaining and providing unique genetic resources.

ISU Curator Brenner released a new white-seeded vegetable line of *Amaranthus cruentus* (DB 2006306) in 2010 (http://www.agron.iastate.edu/cad/amaranth.html).

Outreach and Scholarship:
Approximately 305 visitors toured the NCRPIS during 2010, including international genebank administrators in Ames for GRIN-Global training. Our staff participated in teaching students from grade K to postgraduate level, and provided outreach events to civic and other organizations about germplasm conservation and management, and the work done at the NCRPIS. Scientific and technical staff members continue to publish scholarly journal articles, make presentations at scientific meetings, and supervise graduate research programs.

Current and future foci:
Processes involved in regeneration, characterization, and making viable germplasm available are labor intensive. Currently, resources do not allow maintenance and regeneration efforts, including viability testing, to keep pace with demand. We will continue to try to improve conservation methods to better use the resources available to us, and to develop labor and resource saving technologies. We continue to evaluate activities that can be reasonably reduced without sacrificing collection health and quality, and to improve efficiency.

Continued emphasis will be placed on communicating with research stakeholders to identify and address collection development needs. Crop collections for biofuels and medicinal/nutriceutical applications need to be enhanced; wise selection of targets for these efforts requires use of complex and varied sources of information. In 2010, collection expeditions acquired *Helianthus* from the southern and south central U.S., *Fraxinus* from the central U.S., wild spinach relatives from the High Plains; and *Chenopodium* and *Amaranthus*. *Thlaspi* acquisition is anticipated via collaborators.

Better characterization information is essential to enable well-targeted use of the collections, especially given the increasing constraints of limited research and conservation resources. Collaboration between vegetable curation staff at the NCRPIS and ARS researchers in Wisconsin focused on *Daucus* characterization and

taxonomy in 2009 and 2010. A major effort to phenotypically and genomically characterize the entire maize inbred collection was conducted in 2010, and will be repeated in 2011. Oilseeds curation staff will increase the *Thlaspi* and *Camelina* collections in order to better support biofuel researchers, and currently conduct research to support their agronomic development and utilization.

Horticulturist M. Widrlechner serves as chair of a national Technical Review Team that provides technical direction and oversight to an ARS project to update the USDA Plant Hardiness Zone Map using the best available technologies and data sets, and make it accessible via the Internet. The project is complete, save for public distribution. In addition, he served as an investigator on an NIH grant to develop collections of medicinal plants and elucidate the basis of the phytopharmaceutical activity, and works to develop inter-agency coordination of *Fraxinus* collection in the face of the Emerald Ash Borer threat. Curator L. Marek serves as co-PI on a USDA/DOE grant to evaluate woody biomass traits in sunflower. In addition to extensive phenotypic data capture, and providing germplasm seeds and tissues in support of the genetics and genomics project aspects, extensive images were captured in 2010 and will continue to be in the future.

Software development efforts for the next two years will center on the development and deployment of the successor to the GRIN system, GRIN-Global - its schema, internal and public interfaces. These efforts are facilitated by contributions from germplasm stakeholders in the U.S. and abroad, as we seek examples of use cases and desired features and functionalities of the new system.

V. IMPACTS OF GERMPLASM USE BY NORTH CENTRAL REGIONAL RESEARCHERS:

Impacts of germplasm use by the researchers at the NCR institutions:
A detailed list of examples of germplasm use in research being conducted at NCR institutions was not requested of the RTAC members this year. Please see Appendix Table 6 for a summary of the various CSREES (now NIFA) regions' order history, illustrating the demand for plant genetic resources to support research and educational activities. NC7 Region researchers typically account for nearly half of domestic plant germplasm distributions. Requests for germplasm continue to increase for research as well as non-research use. Requests become increasingly better targeted as the quantity and quality of information associated with the collection improves.

The linkage of the GEM Project, the maize curation project, and public and private collaborators throughout the U.S. has resulted in synergy which facilitates the use of exotic maize germplasm by public and private sector maize researchers. This unique partnership offers great potential for diversifying the genetic base of U.S. maize production, the purpose of the GEM Project.

Linkages among project participants and with other projects/agencies and contributions of the Regional Technical Advisory Committee:
Linkages are driven primarily by common research interests and objectives and by the heritage of the germplasm material utilized for research and education. All states utilize germplasm provided by the NCRPIS and many of the other 20 sites involved in the NPGS; the states have a complex array of collaborative research efforts between their institutions, and with the plant genetic resource curators at the NPGS sites.

The Regional Technical Advisory Committee (RTAC) has provided valuable direction in the following areas:

- requesting and suggesting organizational structure of information needed to determine project impact and provide accountability. This includes advice on useful formats for analyzing and evaluating the nature of distributions, whom they benefit, and how benefits are realized, which are essential for determining the impact and value of the project.
- identifying needed improvements to the public GRIN interface.
- providing input from their respective AES Directors to curators, genebank and other administrators.
- providing guidance to increase the NCRPIS program's relevance to NCR stakeholders.
- providing technical expertise, particularly in the areas of diversity assessment and taxonomy.
- providing added breadth in understanding issues at genebanks beyond the NCRPIS.
- understanding of challenges faced by public researchers partnering with other public institutions' researchers, both governmental and non-governmental. This has provided useful insights for ARS and NCR administrators to guide programmatic decision-making, as well as operational guidance; this function is key because of its direct impact on the public interest as well as the specific research interests of more directly involved stakeholders.

The technical committee gatherings provide an opportunity for the AES Directors' representatives to learn about and understand strategic issues which impact how their institutions operate and how they can cooperate more effectively to address their mission in today's environment, and then provide this information to their Directors.

Some of the NC-7 RTAC's specific suggestions and contributions from their 2010 Annual Meeting include the following:

- The 2010 RTAC meeting hosted by the Northeast Regional Plant Introduction Station in Geneva, NY highlighted the extensive investigations of NC-7 participants using plant genetic resources to explore new agricultural products and new cropping systems. The opportunities afforded by the meeting and field tours are key to establishing the types of collaborative

relationships that lead to long-term partnerships for major research and development efforts.

- Crop Germplasm Committees must be encouraged by the leader of the National Genetics Resource Lab and Database Management Unit to ensure that CGC annual reports are made current and that they fulfill their obligations.
- Clarity on correct and consistent access to germplasm resources is needed and appreciated.
- The NC-7 RTAC supports the efforts of the ASTA and other stakeholders to actively pursue doubling of federal funding available to support this project and maintain its operations at the current level.
- Instructions should be developed and posted on the NPGS website on how to appropriately credit curators and other NPGS entities for their contributions to the success of research efforts (repeat from 2007).
- Results of efforts to improve the public GRIN interface for ease of use and information delivery are highly anticipated.
- Insufficient numbers of individuals are being trained in plant breeding and genetics, plant pathology, entomology, and related disciplines to meet current and future US needs; this is of serious concern (repeat from 2007).

VI. SUPPORT TEAM REPORTS:

A. Farm (L. Lockhart, L. Crim, B. Buzzell)

We supervised and coordinated daily operations at the NCRPIS farm, including management of all facilities, fields, and greenhouse space. We supervised or conducted pesticide applications in the field and campus greenhouses. We responded to maintenance requests from staff members at the farm and the campus location. We selected, coordinated, and scheduled the student labor force of 19.0 FTE's. We coordinated and completed facility construction and upgrades.

Labor:
During 2010, 68 applications for hourly employment were received and reviewed. There were 47 interviews, resulting in 43 new or returning hourly employees hired. Currently there are 36 Biological Science Aides (13.1 FTE) working at the NCRPIS.

NCRPIS Farm Crew Personnel:
Larry Lockhart (Program manager II) has been on staff since 1985.
Lloyd Crim (Equipment Operator III) joined the staff in March 1998. He is now working half-time for the farm support group and half-time for the oilseeds project.
Brian Buzzell (Farm Mechanic) joined the staff in May 2002.
Scott McCubbin's (STEP) efforts were shared with the pollination project.

Maintenance projects:
During the past year the farm staff initiated and completed the following projects which enhanced the efficiency and safety of the station operations.

1. Replaced the framework and Kool-Cel on the Entomology Greenhouse
2. Remodeled Horticulture Technicians office using excess furniture from NADC
3. Added additional motion sensors to control lights in unoccupied rooms
4. Designed and constructed a portable seed drying unit for use on collection trips
5. Designed and constructed a rotating light hanging system for the gradient table
6. Reshaped waterways and installed drainage tile intake in Field C

Purchasing:
Larry Lockhart coordinated purchasing for the NCRPIS farm: this task included gathering and summarizing requests, writing specifications, and obtaining supplies for the farm. Major purchases included the following:

1. 135 Sunflower Cage Frames to replace those damaged in summer windstorm
2. 195 7×7×20 Cage Frames
3. Regi Weeder for single row plots

Tours:
This past year, we organized and conducted 11 tours. There were approximately 305 visitors to the NCRPIS during 2010.

Staff Training:
We conducted Tractor and Utility Vehicle Safety, Worker Right-to-Know and Worker Protection Standard training sessions for the new staff and student employees as well as updates for existing staff.

B. Information Technology and Telecommunications (P. Cyr and J. Perrett)

Jesse Perrett has been acting as the first-line of IT support for NCRPIS during 2010. Jesse was supervised by Pete Cyr, who has been temporarily re-assigned to manage a 3-year project to rewrite the GRIN (Germplasm Resource Information Network) System. The following list outlines the progress made by the IT team during 2010 at NCRPIS.

Equipment:
As of December, 2010, the NCRPIS had 64 workstations installed for use by permanent staff members and part-time temporary student help. In 2010, 10 workstations were deployed to replace aging curatorial staff desktops. The new workstations were Dell Optiplex 745 and 755s. Where possible, the displaced computers were re-commissioned for light duty work in other areas of NCRPIS.

The fileserver used for germplasm image storage and manipulation was upgraded to Microsoft Windows Server 2008 R2 in order to provide enhanced search capabilities and performance. The drives for the imaging server were also upgraded to a new drive array system which uses SATA drives versus old IDE in order to lower cost and increase performance and usability. Fourteen desktop and laptop computers received 4GB memory upgrades to improve speed and reliability. Six servers received memory upgrades, bringing the minimum memory of all servers to 8 GB. The door security system's wireless bridge and the access point to the head house were replaced to provide enhanced security and reliability. Due to a change in configuration, the server which houses the database for the door security system was relocated. We installed, and configured four new, lower cost Plustek scanners for life-cycle replacement. Two aging point and shoot digital cameras were replaced with a Canon Digital Rebel Xti digital SLR, and a Canon Powershot G11 camera in order to improve archival image quality. One Dell XT2 tablet was implemented to improve field data collection.

Software:
Workstations at NCRPIS are operated on a combination of Windows 7 and Windows XP with Service Pack 3 installed for increased security and reliability. Frequent updates to anti-virus definitions and anti spy-ware definitions in conjunction with regular full system scans help ensure that these workstations remain vulnerability-free. The SharePoint virtual server was upgraded to Microsoft Office SharePoint Server and now uses SQL Server 2008 for data storage.

During 2010, all workstations and servers at NCRPIS received security updates from Microsoft every second Tuesday of the month. PatchLink software was used to

manage, track, and apply non-Microsoft software vulnerability patches for all non-Microsoft software in use on the workstations and servers at NCRPIS.

All computer systems on campus and at the farm (servers and workstations) use Symantec Endpoint Protection for enhanced security against virus and spyware threats. The Symantec server software for managing these workstations was updated in 2010. All compatible laptop systems are encrypted using McAfee Endpoint Encryption whole hard drive encryption software. Users who need to load images to the GRIN database as well as remote users facilitate connectivity to ARSNet through the use of Cisco VPN software. The TrackIt help desk software and Retrospect Multi Server Backup software were upgraded to new versions. The rollout of Windows 7 and Server 2008 software is progressing. Testing of Windows 7 and Server 2008 R2 64bit compatibility with current software was completed. A new Windows Server 2008 deployment server was set up to facilitate the rapid deployment of Windows software.

Documentation:
IT support videos and training documents, and information about farm operations, safety, and health were posted to the NCRPIS intranet website. Regular input was provided to the Midwest Area IT office regarding system and component information for data calls.

Plans for 2011:
Continue to replace NCRPIS workstations on an as needed basis (targeting a 3-5 year lifespan for daily use workstations).

Restructure IASTATE Active Directory and implement new group policies to enhance usability of network printers and resources.

Continue upgrading Servers to Windows Server 2008 R2 and desktops to Windows 7 64 bit where possible.

Migrate users to Voice Over IP (VOIP) phone service.

Identify and surplus legacy hardware.

GRIN-Global:
The GRIN-Global project is a joint partnership between USDA-ARS NPGS, Global Crop Diversity Trust and Bioversity International. The goal of the project is to re-write the current GRIN Germplasm Management System in such a way that it can be deployed on any size computer with a minimum amount of effort. The new germplasm management system (dubbed GRIN-Global) will support five different languages, three database systems and install on a single desktop computer or network. In 2010 the NCRPIS team attended a Technical Steering Group meeting in Beltsville, Maryland to discuss and review the achievements of the project in 2010. The highlights of the GRIN-Global team achievements during 2010 are as follows: Enhanced the GRIN-Global client interface (Curator Tool and Search Tool), enhanced the database schema to support new features, created a new application for automating the installation and upgrading of the GRIN-Global system software,

created a new client interface to ease the system administrator's job of managing the GRIN-Global server components, and enhanced the search engine and web services (middle tier) for the GRIN-Global System.

C. Seed Research and Computer Application Development (D. Kovach, M. Erickson)

Seed Research:
Seed research for 2010 included the following genera:

- *Calendula* – Documenting the progress of seed after-ripening at 4 and 23 °C. The primary goal is to document loss of seed dormancy during cold storage. Results are summarized as the experiment progresses.
- *Echinochloa* – In 2010, a paper entitled, "Variation in seed dormancy in *Echinochloa* and the development of a standard protocol for germination testing" was submitted to Seed Science and Technology and published in October: Kovach, D.A., Widrlechner, M.P. and Brenner, D.M. (2010), Seed Sci. & Technol. 38: 559-571. At NCRPIS, we maintain more than 300 accessions of *Echinochloa* representing 15 species from a diverse cross-section of nations and growing conditions. With such a diverse collection, no single germination-testing protocol was adequate for accurately assessing their viability. By manipulating light conditions, we determined that some accessions required light and others required dark conditions. However, no pattern was found for this response based on taxonomy or improvement status. Most accessions tested showed optimal germination when tests were conducted between 25 to 30°C, but both positive and negative photoblastic responses were sometimes expressed, even at lower temperatures. A sequential treatment of darkness followed by light revealed that skotodormancy (dormancy caused by darkness) was being induced in light-requiring seeds. Similarly, a sequential treatment with light followed by darkness revealed that photodormancy (dormancy caused by light) was being induced in dark-requiring seeds. Thus, without prior knowledge of the light requirements of a particular accession, we concluded that a side-by-side germination test where two replicates receive periodic light (12 hours at 30°C / 12 hours dark at 20°C) and the other two are tested in darkness (12 hours at 30°C / 12 hours at 20°C) is best for *Echinochloa*. This approach was recommended for germplasm centers, seed-testing laboratories, and others working with genetically and geographically diverse *Echinochloa* seed lots.
- *Zea* – Provided editorial feedback for Mark Widrlechner, Allan Trapp (ISU graduate student in statistics), and Philip Dixon (ISU professor in statistics) to help develop a statistical model to predict the trajectory of seed deterioration over time that can be used to efficiently schedule future viability tests. The results of this statistical analysis will be prepared for submission to the Journal of Agricultural, Biological, and Environmental Statistics in 2011.

Germination Testing:
During 2010, Maria Erickson and her crew conducted germinations on over 2,400 accessions.

Curator	Major Crop Tested (Accessions)	Total Accessions Tested
Brenner	Amaranth (62)	225
Marek	Flax (176)	227
Millard	Maize populations (650)	984
Qu	Medicinals (37)	37
Reitsma	*Cucumis melo* (707)	845
Widrlechner	Ornamentals (109)	118
	Total:	**2,436**

Computer Application Development and Graphics Support:
In 2010, David Kovach continued maintenance work on computer application forms and reports designed to retrieve data from the GRIN Database, and used statistical software packages to run descriptive statistics. He continued to serve station needs by providing AutoCAD drawings and large-format printing for professional posters and local use.

He also obtained a new large-format printer, a Canon imagePROGRAF 8300 (iPF8300). Wilhelm Imaging Research (WIR), an independent ink-permanence testing laboratory, gave the iPF8300 a WIR "Displayed Prints Framed Under Glass" permanence rating of up to 95 years for color images, and greater than 200 years for black-and-white output, and reported that these prints are also very resistant to damage from high-humidity environments, ozone exposure and water. This printer has the capability to print to the paper's edge and print on outdoor-type media, i.e., for field day display. Accompanying software allows for splitting print jobs into multiple pages, which together with the print-to-edge technology, allows for printing very large displays.

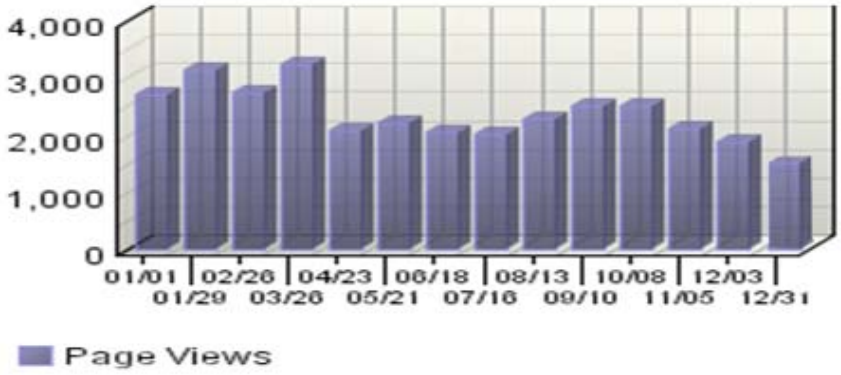
Internet website related:

- In 2010, David Kovach maintained the station's website (www.ars.usda.gov/mwa/ames/ncrpis),
- deployed a new NPGS Ash Conservation Website (www.ars.usda.gov/sp2UserFiles/Place/36251200/Ash_Project/HomePage.html),
- and upgraded the Ames Area Civil Rights Advisory Committee (AACRAC) Website (www.ars.usda.gov/sp2UserFiles/ad_hoc/36250000AACRAC/AACRAC_Project/HomePage.html).
- He also continued to post posters, PowerPoint presentations, updates of germination test methods, personnel biographic data, and other updates to the station's website as needed.

Page Viewing Summary for Year 2010
The following table summarizes the user activity of our public website.

Page View Summary	
Page Views for 2010 Year	31508
Average per Day	86
Average Page Views per Visit	2.41

Page Viewing Trends for Year 2010 – All Categories
(Y-axis: number of page views; X-axis: date.)



In 2010, 31,508 page views were reported. With an average of 86 views per day and 2.41 pages per visit, we averaged about 35 visitors per day. The gradual decrease in visits from October to December is typical of user visits to USDA websites during the holiday seasons.

Page Viewing Trends for Year 2010
(Top Five Categories – color key shown in following table)

Pages Visited (top 25 visited pages in 2010)	Number Visits
Home page	3,728
Hardiness Zone Maps – China	945
Research Project: Proposal to Develop New Plant Hardiness Map Data for the United States	786
NCRPIS Staff List – permanent staff page	738
Hardiness Zone Maps – Ukraine	666
News and Events – Archived Items	630
Station Information – Ordering Germplasm	594
People at this Location – includes students	467
Station Information – printout of all pages in section	397
Hardiness Zone Maps – printout of all pages in section	385
Personnel Page – Mark Widrlechner	323
Publications at this location	312
About Us – Mission Statement	306
Station Information – Crops Maintained pie chart	299
Pollinators at PI – printout of all pages in section	293
Maps – NC United States Moisture Balance	275
Station Information – Station Facts and Purpose	265
Germination Test Methods	256
Careers – Student Hourly Employment	255
Pollinators at PI – introduction page	238
Germplasm Enhancement of Maize	235
Personnel Page – Mark Millard	226
Maps – List of Maps	223
Contact Us	206
Station Information – Seed Storage Conditions	198

In 2010, many visitors to our station website were interested in the hardiness zone maps of China and the Ukraine, as well as the proposal to develop a new plant hardiness zone map for the US. Interest in our staff and student employees was evident, perhaps due to prospective employees seeking information or website visitors seeking personnel contact information.

Cooperative efforts:
In 2010, David Kovach contributed to the following station-wide projects:

- Statistics
  - Station Statistics – these are reported in each year's annual report.
  - Modified Statistics Programs – adapted statistics programs to meet individual curator requests for data on specific groups of accessions.
- Special printing requests
  - Station Brochures (≈ 650 glossy and 200 paper).
  - Posters (PAG-Grin Global, World and US Distribution Maps, Maize Genomic Project, AAIC-*Camelina*, CSSA-*Thlaspi*, ASA-GEM, ASA-*Camelina*, ASA-Grin Global, AISES-student outreach project, Maize-field maps, VEISHEA).
  - Large spreadsheet for vehicle quarterly repair and service chart.
  - AutoCAD drawings (metal tubing specifications for cage frames).
- Special lighting for the thermal gradient table
  - Researched red, far-red, and green safe light options and sought advice from researchers in phytochrome-related research.
  - Obtained a Light Emitting Diode (LED) system.
    - Lights emit a fair to moderately narrow range of light targeted at 660, 730, and 525 nm.
    - Red light (660 nm) often promotes germination.
    - Far-red light (730 nm) reverses this action, and often prohibits germination.
    - Green light (525 nm) has low photo-activity, but provides "safe" light for research personnel.
  - A rotating bracket system to hang the lighting system and enable fast, easy conversion of regimens was designed and built by Brian Buzzell.

In 2010, Maria Erickson contributed to the following projects:

- Special Germination Requests
  - GEM – germination tests on maize germplasm that is not in GRIN and requires non-standard data processing.
  - Medicinals – assisted Luping Qu by conducting specialized experimental treatments on *Prunella* and *Echinacea* seed.
- Chemical inventories
  - Inventoried chemicals used for seed-viability testing, and assisted in tracking other chemical inventories held at the station.

Special Training:
Maria Erickson continues to work on her Master of Science program at Iowa State University. Her program of study is Interdisciplinary Graduate Studies / Biological and Physical Sciences, emphasizing statistics, botany, and physiology.

Plans for 2011:
Calendula work will continue on a long-term project to document loss of seed dormancy during cold storage. Stored seeds are tested for germination every six months. If time permits, more experiments on breaking *Echinochloa* seed dormancy will be conducted.

David Kovach will work to develop reports for printing labels, inventory reports, and station statistics, using Visual Studio and Crystal Reports, in conjunction with the GRIN-Global Project, a revised database and new computer interface for national and international germplasm information systems.

D. Information Management-Germplasm Collections (R. Stebbins, R. Beyer)

Acquisition:
The North Central Regional Plant Introduction Station (NCRPIS) acquired 516 new accessions in 2010, the ninth highest amount in the last 15 years. Of these new accessions, 332 were received from within the National Plant Germplasm System (NPGS) through exploration and transfer. This included 70 accessions of ornamentals (67 of these were from collection trips conducted by NCRPIS personnel), 67 accessions of cultivated *Helianthus* (34 from the Northern Crop Science Laboratory in Fargo, ND and 33 from the National Center for Genetic Resources Preservation (NCGRP)), and 56 accessions of wild *Helianthus* from a collection trip conducted by NCRPIS personnel.

The remaining 184 accessions received from outside the NPGS included 63 accessions of *Zea mays* subsp. *mays* from the International Maize and Wheat Improvement Center (CIMMYT), 55 accessions of *Zea mays* subsp. *mays* from various domestic sources, and 39 accessions of ornamental crops, also from various domestic sources.

As new accessions are recorded in the Germplasm Resources Information Network (GRIN) database, we include as much passport information as possible. Typical passport information would include a source history, cooperator records, collection-site description and geographic coordinates for wild collections, pedigree, secondary identifiers, and any other pertinent information provided by the donor.

Maintenance:
Robert Stebbins provided curatorial assistance by processing requests for taxonomic re-identifications and nominations of accessions to the inactive file. In total, 147 accessions received taxonomic re-identifications. Among these were 73 accessions of *Daucus*, 16 accessions of other umbels, and 11 accessions of *Amaranthus*. Also, 26 accessions were nominated for inactivation, including 22 accessions of ornamental crops. Three of these were inactivated due to duplication. The inventory lots of these accessions were integrated together with lots of their respective duplicates.

Additionally, 54 accessions were assigned PI numbers. Included in this group were 20 accessions of *Chenopodium*, 10 accessions of *Amaranthus*, and 9 accessions of ornamentals.

Projects:
Robert Stebbins worked with Mark Widrlechner to prepare 13 accessions of mints and ornamentals for PI-number assignment. Any errors in GRIN were corrected, and reports were printed for a final check before requesting PI numbers.

Beginning July 1, Robert integrated the use of enhanced order-action codes into the standard operating procedures for processing germplasm requests. As a result of the enhanced order actions, NCRPIS personnel have a better tool for tracking the progress of orders. Robert has also developed and documented a method to track shipment costs by use of these new order-action codes.
In October, Robert began a second two-year term on the Ames Area Civil Rights Advisory Committee (AACRAC). The primary role of this committee is to promote general awareness of civil rights issues and foster opportunities for career development of minorities in agriculture. The committee holds monthly meetings and organizes activities to coincide with nationally recognized observances. Robert also works with David Kovach to update and maintain the AACRAC website.

Robert is on his second year of a three-year term on the Midwest Area Equal Opportunity Advisory Committee. The committee is sponsored by the Area Director. Committee members play three roles: 1) providing location perspectives to the committee on outreach, partnerships, special-emphasis programs, etc., 2) serving as a location liaison to/from the Area Office to help initiate/coordinate outreach related items at the location, and 3) being a location contact and resource.

Robert and Rachael Beyer volunteered to work at the NCRPIS exhibit at VEISHEA.

Robert coordinated with Dr. Susan Brockmeier at the National Centers for Animal Health (NCAH) to enter the first booth from the NCRPIS in their annual Science Fair for middle school students. At our booth, Robert and Rachael talked to the students about the some of the unique seeds in our collection and their uses (illustrated below).

Rachael continued to inventory journals and new library acquisitions and entered this information into the NCRPIS Sharepoint database, thus allowing curators and staff increased ability to access all of our joint or individual library holdings.

Conclusions:
Compared to 2009, new accessions received at NCRPIS were down by 193 in 2010. Among the maintenance areas, re-identifications were up by 96%, nominations to the inactive file were down by 89%, PI-number assignments were 43% lower, and resolved duplications were 70% lower than for the previous year. The number of new accessions acquired and the totals for the four accession maintenance areas noted above were all below their 15-year averages.

E. Order processing (R. Stebbins, R. Beyer)

During 2010, 1,778 orders were entered into GRIN. These orders led to the external distribution of 27,651 items (primarily seed packets, but also vegetative samples) (Table 3A-1). Of these, 19,831 items (72%) were distributed within the United States, and 7,820 (28%) were sent to foreign requestors. Additionally, 8,649 items (Table 3B) were distributed within the NCRPIS, for such uses as regeneration, evaluation, and germination and disease testing.

The number of orders entered into GRIN in 2010 was 13% less than that of 2009; however, the number of items distributed was up by 1,522 or 4%. The number of requests received electronically this year was 1,456, a decrease of 12% from 2009.

In order to increase the depth of staff expertise and capacity to handle seed distributions, Candice Gardner requested that Robert mentor Rachael in all aspects of order processing, including the public GRIN request system, GRIN order-processing functions, methods used to communicate with the curators and plant pathologist, and those for US Mail and FedEx shipping, internal filing, and the processing of international requests. As established in 2009, all germplasm requests that involve only accessions curated by Kathy Reitsma continue to be processed by Rachael, and she is included along with Robert in all email exchanges regarding pending requests.

F. Seed Storage (L. Burke, L. Pfiffner)

Two full-time, permanent federal employees (Lisa Burke and Lisa Pfiffner), and one part-time, temporary student staffed the seed storage area. Lisa Pfiffner continued to serve as the federal supervisor for several of the crews led by state employees.

In 2010, we stored 1,998 inventory lots, including 720 original seed lots. Of the original lots stored, 372 were *Fraxinus*, along with 58 *Zea*, 109 *Helianthus*, 73 *Daucus*, and 26 *Gymnocladus*. Of the increase lots, 879 Ames increases, 384 non-Ames increases, and 44 check lots were stored. During storage, 300 lots were bulked with previously regenerated samples to create 135 new bulked lots, 129 of which became available for distribution. Of all stored lots, 793 lots were made available for

distribution. We split 144 original lots to make them available for distribution in limited quantities. We reviewed 2,372 inventory lots for seed quantity, and any discrepancies were corrected in the GRIN database. 544 samples were prepared and transferred to a -20C freezer for long-term storage.
In 2010, 147 accessions received taxonomic re-identification. We re-labeled the 251 seed samples affected and filed the pertinent documentation. In addition, seed samples of 17 inactivated accessions were removed from the active collection and placed in inactive storage. We also re-labeled 125 seed lots associated with the assignment of 54 new PI numbers, and then corrected their cold-storage locations in GRIN to reflect changes in numbering.

We filled 1,344 seed orders in 2010, including those for distribution, observation, germination, transfer and backup. There were 1,012 lots sent to the National Center for Genetic Resources Preservation (NCGRP) for backup, involving both accessions new to NCGRP and supplemental lots for previously supplied accessions. Three orders of *Fraxinus* accessions were sent to NCGRP for "Black Box Backup" totaling 623 inventory lots. NCRPIS distributed 27,099 packets (the majority filled by seed storage personnel) to meet distribution and observation requests. We transferred 19 inventory lots to other NPGS sites. 19 germination orders were filled, involving 764 lots.

2010 saw the continuation of the prepacking program. With the aid of our student worker, we prepacked 18,327 packets of 1,494 inventory lots. A large portion of the prepacking program focused on recently acquired, expired PVP maize accessions. Most of these accessions are in high demand as soon as they are received. Prior to regeneration, the distribution lots (original seed) are prepacked in 15-kernel packets. Once the accession has been successfully regenerated, standard distribution amounts are prepacked from the new lot. In 2010, we received 48 expired maize PVP accessions, which in turn were distributed as 1,240 order items in 134 orders.

NCRPIS continued to participate in sending seed to the Svalbard Global Seed Vault in 2010, by preparing 1,936 accessions for backup there. Sample amounts ranged from 200 to 800 seeds depending on the amount of seed needed for two regenerations. For tracking purposes, an inventory action code (SVALBARD) was added to all lots shipped. Packets were filled and orders sent to NCGRP for repackaging and consolidated shipment to Svalbard.

Seed storage personnel continued to maintain the germplasm distribution display in the farm headquarters hallway. New maps were printed at the start of 2010, and domestic and international distribution destinations were noted.

Scanning of original seed samples continues. In 2010, 391 scans were captured, mostly of original samples. 58 of those accessions were of *Fraxinus* from North American collections. We continue working with Jeff Carstens to streamline the imaging and storing process for *Fraxinus*.

Some imaged samples were new to the station while others were being pulled for regeneration when the entire sample was needed. Creating a visual reference of

seed lots that have been used up for planting is important to allow future comparisons with the increase lots by curators and storage personnel.

In the summer of 2010, the station continued to participate in the National Science Foundation-funded outreach to Native Americans on Plant Germplasm and Genomes intern program. One student from the Navajo Nation worked with seed storage personnel to learn basics of genebank management, with a focus on Navajo maize accessions held at the station.

Lisa Burke continued to participate in the development of GRIN Global. She attended a GRIN-Global "Train the Trainer" session held in Ames in November 2010.

Lisa Pfiffner continues to work on Purity Analysis studies as the primary staff member working with new original seed samples, thus familiarizing herself with many types of seeds and potential contaminants

Lisa Burke continued as the station's CPR/AED/First Aid instructor. Six classes in First Aid, three in CPR/AED and two in AED/CPR/First Aid occurred during 2010, with 46 permanent and student NCRPIS staff members trained.

VII. CURATORIAL AND SCIENTIFIC TEAM REPORTS

A. Controlled Insect Pollination Service Program (S. Hanlin, S. McClurg)

Progress:

Caged pollination:

Bee pollinators (minus the alfalfa leafcutting bee) were supplied a single time to 480 cages for controlled pollination of 407 accessions. Alfalfa leafcutting bee and fly-pollinated cages are tabulated and reported separately due to multiple distributions of those insects to the same cages over the pollination season.

Honey bee pollination (Hanlin):

Honey bees were used to pollinate 327 accessions in the field and 7 accessions in the greenhouse.

58 parent colonies of honey bees and 53 double-story nucleus colonies were overwintered in the indoor wintering facility in late 2009. There was a survival rate of 66% for parent colonies and 8% for nucleus colonies, which was lower than spring 2009 at 76% and 38%.

2010 Honeybee Pollinator Deliveries to Regeneration Cages

Crop Group	Total # of Accessions	# of Genera	# Accessions / Genera
Oilseeds	84	6	73 *Helianthus*, 6 *Cuphea*, 2 *Erysimum*, 1 *Aurinia*, 1 *Brassica*, 1 *Crambe*
Vegetable	117	3	82 *Cucumis*, 24 *Daucus*, 11 *Cucurbita*
Horticulture / Medicinals	93	8	38 *Hypericum*, 20 *Echinacea*, 14 *Cornus*, 8 *Rhus*, 7 *Prunella*, 3 *Ligustrum*, 2 *Physocarpus*, 1 *Baptisia*
Misc.Umbels	33	2	24 *Melilotus*, 3 *Angelica*, 3 *Zizia*, 2 *Erynigium*, 1 *Petroselinum*
Total	**327**	**14**	**816**

We left 24 three-story parent colonies outside at three locations. All outside colonies were wrapped in groups of two or three with 40 lb. tar paper; the survival rate was 37%. We had a heavy snow starting on December 8, 2009 burying the parent colonies and nucleus hives that remained outside. Snow cover conditions lasted until early March (an unusual situation); at that time all hives were then removed from indoors or unwrapped for the spring. In December 2010, we over-wintered indoors 58 double-story parent colonies, 41 double-story nucleus hives, and 16 single-story nucleus hives. We moved and wrapped 17 three-story parent colonies to the station which we over-wintered outside.

To prepare for early spring 2010 cage pollinations, 50 “Buckfast” queens were purchased. From our over-wintered colonies we made 50 nucleus hives with two frames of brood and three frames of adhering bees for each nuc in late April and

placed a caged queen in each of those nucs; by early-May productive nucs were ready to place into cages. This protocol allows a limited supply of hives prior to the start of our queen grafting efforts, in order to fill early spring pollination requests. Two nucleus hives were needed for miscellaneous Umbel pollinators in mid-April and queen-less nucs were used since queen-right nucs were not yet available.

We supplemented our over-wintered bees with 24 "Buckfast" 3-pound bee packages received in mid-April, 2010. The packages were placed into full size hives and given three feedings of high fructose corn syrup and two pollen treatments.

In mid-May we selected queens from resilient, over-wintered parent colonies to use for producing queens for nucleus hives during summer 2010 and set them up in cell builder colonies. Queen rearing throughout the summer 2010 produced an average of 28 queens per week. During much of June and July, only one frame of queens was grafted weekly because of reduced student labor availability. Nucleus hives were produced until early August; hives not used in cages for pollination were fed and strengthened for over-wintering.

In September, all strong double and single story nucleus hives were made into colonies. In the past, strong single story nucs (five to six frames of bees) were doubled with a super being placed on top of the original hive for over-wintering. We observed that a large number of these stronger nuc hives did not survive the winter because of lack of stored feed, and that being directly put into a larger ten-frame double hive with extra frames of honey could increase the survival numbers. All medium-strength single story nucleus hives containing three to four frames of bees were doubled to prepare them for over-wintering. Any nuc with less than three frames of bees was left as a single and kept in the over-wintering room for winter greenhouse pollinations.

In late June, hives were removed from the Atomic bee-yard because of possible flooding and falling trees. In early August, the hives were removed from the Hines farm because of rising waters in the nearby South Skunk River. Both yards had worse flooding in early August than in 2008. No hive loss occurred and only minor damage to H-frame stands was observed.

As part of regular bee-health assessment, in April 2010 all surviving over-wintered hives were sampled for mites. The population range of mites found was 0 to 20 with an average of 15 mites per 100 bees. Because of the low mite counts, no treatment was applied in the spring. Mite populations in the spring 2010 were determined using the "sugar roll" method: 1 tablespoon of powdered sugar was placed in a pint jar with 100 bees randomly sampled from the hive. Bees were rolled in the sugar and then shaken vigorously over a white pan; mites that dropped off into the pan were counted. A fall sampling of 50% of the hives in September using the sugar roll method produced an average of 20 mites per 100 bees. Two treatments of Apiguard® (thymol - an organic product) were applied over a four week period to all colonies and nucleus hives.
All parent colonies and nucleus hives were given two treatments of Fumagilin – B® in March 2010, after removal from the over-wintering room. In early October 2010, all hives being prepared for over-wintering were given three medicated feedings

prior to placement in the over-wintering room. Fumagilin-B® is used for prevention of dysentery [nosema].

For wax moth control during the summer of 2010, new methods were evaluated as alternatives to Para-moth® (para-dichlorobenzene) crystals, which have been documented as a carcinogen. First, all frames were stacked during the winter of 2009/2010 in one of two fashions: either a) supers (boxes of frames) were stacked at right angles to each other, allowing more light and ventilation between the frames and discouraging moth activity, or b) supers were separated by single sheets of newspaper to prevent pest movement between supers, thus limiting the infestation to localized areas. Secondly, the lights in the north equipment room were left on during working hours also to discourage insect activity. A third trial involved placement of "fermentation traps" at several locations around the stacks of frames to attract adult wax moths found near outside beehives. The traps consisted of plastic gallon bottles containing a mixture of water, sugar, vinegar, and a banana peel. During the summer of 2010, very few wax moths were observed in the stacks of frames and no adult moths were observed in the traps. Because we are not sure whether this was due to a low moth population year or if our alternate controls worked effectively, we will continue to observe results using the same control methods in 2011, utilizing the "environmental control method" with equipment stacked in an unheated storage area. Wax moth does not tolerate extended periods of extreme cold, so pest emergence should be reduced.

Use of our syrup feeding system of two 1,000 gallon polypropylene tanks (one inside the shop and one outside), a 30 gallon poly "mixing" tank and a dish washer for cleaning syrup jars continues with good success. An immersible heater was used to liquefy the contents of the supplementary storage barrels prior to transfer of syrup into one of the poly tanks. To prevent crystallizing of the high fructose corn syrup (HFCS) in the large interior storage tank, the contents were mixed with water and circulated by running the pump for at least five minutes daily. During the months of June through August 2010, every other feeding of caged nucs was high fructose corn syrup supplemented with the feeding of solid fondant sugar. Every other week, a 2"×2"×¼" block of fondant was placed in the feed-hole of all nucs and allowed to form a syrup from the moisture in the air. The bees would then feed from the pool of syrup around the fondant block. Because bees do not store syrup collected from fondant as they do the HFC syrup, in September all cage nuc feedings were switched back to HFCS.

All bee locations were georeferenced and registered with the Iowa Department of Agriculture and Land Stewardship (IDALS) to assist pesticide applicators in locating bee-yards and notifying appropriate beekeepers prior to spraying nearby.

<u>Bombus pollination (Hanlin)</u>:
Six "mini-research" colonies of *Bombus impatiens* were purchased for use during the spring/summer of 2010 from a commercial supplier and used to pollinate 17 field cages with 16 accessions. One *Bombus* colony can be used for pollinating more than one cage with a minimum lapse of 48 hours between sites to prevent pollen contamination.

2010 *Bombus* Pollinator Regeneration Use

Crop Group	Total # of Accessions	# of Genera	# Accessions / Genera
Horticulture / Medicinals	9	4	5 *Baptisia*, 2 *Caragana*, 1 *Ciervilla*, 1 *Echinacea*
Vegetable	3	1	3 *Cucumis*
Misc. Umbels	2	1	2 *Melilotus*
Oilseeds	2	1	2 *Helianthus*
Total	**16**	**7**	

We continued to use 60-quart protective plastic containers to house the cardboard *Bombus* hives while in field cages. The plastic container and hive were placed on a stand consisting of a honey bee hive body and lid; two water-filled quart containers were placed on either side of the hive to prevent the wind from blowing the container and hive off of the stand.

Osmia cornifrons/*O. lignaria* pollination (Hanlin):

Osmia were used to pollinate a total of 53 field cages and ten greenhouse cages with 64 accessions all together.

We need ca. 1500 *Osmia* bees total each year to supply field cages and to place at "increase" sites for obtaining an adequate supply of bees for the next year's pollination season. In the 2009 growing season (which would provide bees for 2010), there were fewer *Osmia* bees available overall; we ended up with ca. 216 bees from our 2009 increase to use for the 2010 pollination season.

2010 *Osmia* Bee Pollinator Regeneration Use

Crop Group	# of Cages*	Total # of Accessions	# of Genera	# Accessions / Genera
Brassica Oilseeds	33/14	47	7	26 *Brassica*, 10 *Crambe*, 4 *Erysimum*, 3 *Lepidium*, 2 *Matthiola*, 1 *Aurinia*, 1 *Thlaspi*
Horticulture / Medicinals	12/4	16	7	5 *Cornus*, 4 *Aronia*, 2 *Potentilla*, 2 *Spiraea*, 1 *Berberis*, 1 *Calendula*, 1 *Physocarpus*
Misc. Umbels	0/1	1	1	1 *Melilotus*
Total	**53/10**	**64**	**15**	

*field/greenhouse

The situation improved in spring 2010 with the purchase of 2250 additional cells from three commercial suppliers. The overall total of ca. 2400 bees provided adequate populations of bees for 2010 cage pollination and for placing domiciles at four total "increase sites" in 2010. We have expanded the number of *Osmia* increase locations to avoid the loss of potential bees which had occurred when relying on a single increase location.

The total 2,466 bees on hand in 2010 were used to fill 138 domiciles; of these, 53 *Osmia* two-inch domiciles were used in germplasm pollination cages. Three-inch diameter domiciles were placed in trees at the four *Osmia* increase sites as follows: 24 domiciles were placed at Water Works Park (Des Moines, IA), 18 domiciles were placed at The Berry Patch (Nevada, IA), ten domiciles were placed at Dean Biechler's (Gilbert, IA), and ten domiciles were placed at the Iowa Arboretum (Madrid, IA). The remaining 23 two-inch domiciles (normally used in cages) were also placed at The Berry Patch in late June rather than discarding the unused bees.

We collected ca. 1,732 bees from our own "increase domiciles" in 2010 for use in the spring of 2011. The three commercial suppliers of *Osmia* which were used in 2010 were not able to supply bees for 2011 because of poor increases they experienced. The 2010 locally-produced "increase" bee numbers should be adequate for cage pollination in 2011, but there may be a reduced number of domiciles placed at local "increase" sites.

We accurately tracked the physical location of the *Osmia* domiciles at increase sites for retrieval later in the summer (when they may be hidden by foliage), by using a GPS unit and paper maps. As domiciles were placed in the early spring, coordinates were recorded from the GPS unit and each domicile position was plotted on a map. Because of past accuracy problems with hand drawn maps, we created maps using "Google-Earth" so that domiciles could be more accurately found in the correct tree.

Alfalfa leafcutting bee (ALC) *Megachile rotundata* (McClurg):

ALC bees were purchased as larvae in leaf cells from a single supplier for use in 2010, arriving in Ames, IA on 3 Dec 2009. The bee cells were held in refrigerated storage until scheduled for placement in warm incubation and bee emergence boxes. Bees were available weekly throughout the year for use in plant regeneration cages in the field and greenhouse from early January through the end of December 2010.

In 2010, 816 total ALC deliveries were made to a total of six fields and three greenhouses with 140 cages containing 134 accessions representing 14 genera and 44 plant species/subspecies. Nine Vegetable cages and one of the Horticulture accessions were still undergoing pollination at the end of 2010 into 2011.

2010 Alfalfa Leafcutter Pollinator Deliveries to Regeneration Cages

Crop Group	# of Deliveries	# of Cages	# of Locations	# of Accessions	# of Genera	Time Period
Misc. Umbels	9	4	1	3	2	June – mid-Aug
Brassica-Oilseeds	145	38	2	39	6	May – Oct
Horticulture	167	21	5	21	4	May – Sept
Vegetables	495	77	3	71	2	Jan – Dec
Total	**816**	**140**	**9**	**134**	**14**	**Jan - Dec**

Numbers of active ALC-supplied cages and frequency of bee delivery vary seasonally and by cage structure/location and individual accession characteristics. In normal pollination situations, ALC bees/cells are provided to crops in the summertime only, but we continue to use ALC cells with success outside of the normal time frame. From January through March, an average of 3 cages (100 %) were supplied weekly with bees, while 84% of active cages (11 of 13 on average) were filled with bees in the spring pollination season. 2010 field requests for ALC bees started in mid-May and the number of weekly active cage increased rapidly through the first week of September. The following chart shows the seasonal cage statistics for ALC bees in 2010.

2010 Low, High, and Average Alfalfa Leafcutter Bee Deliveries to Regeneration Cages

2010 Season – ALC BEES	Winter	Spring	Summer	Fall
LOW no. of active cages/accessions	2/2	3/3	47/46	3/3
HIGH no. of active cages/accessions	4/4	31/32	88/88	13/13
AVG no. of active cages/accessions	3/3	13/13	63/62	10/10
AVG no./ % cages filled weekly	3/100 %	11/84 %	37/59 %	9/93 %

Some changes were required in ALC handling protocols during 2010, because we received domestic sources of increase cells instead of Canadian sourced cells, as in prior years. Fewer Canadian bee cells were produced in the 2009 growing season, so the supplier sent us U.S. cells, in part due to the early delivery required for our annual shipment of new cells (in December). Domestic cells typically have a higher rate of parasites and parasitoids than do Canadian cells, so the supplier sent twice as many cells to make up for an anticipated reduction in bee emergence.

Changes required from our standard handling protocols included the following: 1) Supply additional refrigerated storage locations and containers. We had not received advance notice of the difference in cell quantity or source prior to arrival of the shipment, so we used vented, hard-plastic greenhouse flats lined with cage screening and were granted space in seed storage for extra flats that could not be fit into refrigerated chambers in the Entomology building. 2) Increased the quantity of cells placed in each individual incubation container, the number of containers incubated weekly, and the number of containers placed per emergence box to achieve an adequate number of bees required weekly.

Additional adjustments were made to the original ALC cell use plan in late spring 2010, as the curatorial staff increased requests for ALC bees earlier in the field season than expected, due primarily to more early blooming plants in the field than in the past. This meant that other pollinators had not been requested in advance or were not yet available due to the nature of their life cycles and the weather experienced in 2010. Although the increased demand for ALC resulted in delivery of fewer bees per cage than in past years, effort was made to provide all requested cages with adequate ALC bee coverage.

Flies (Blue Bottle Flies and Houseflies) (McClurg):
Fly pupae of two species (Calliphoridae and *Musca domestica*) were purchased from two suppliers and incubated for use weekly from the beginning of January through the end of September 2010 for caged plant pollinations in both the greenhouse and field. In 2010, 680 fly deliveries were made to a six fields and greenhouses with 87 cages containing 85 accessions representing 18 genera and 32 plant species/subspecies.

2010 Fly Pollinator Deliveries to Regeneration Cages

Crop Group	# of Deliveries	# of Cages	# of Locations	# of Accessions	# of Genera	Time Period
Horticulture	25	9	1	9	3	May – Sept
Brassica – Oilseeds	43	5	1	6	5	Jan – June
Sunflower – Oilseeds	45	9	1	9	1	Jul – Aug
Misc. Umbels	133	17	1	14	8	Apr – Sept
Vegetables	434	47	2	47	10	Jan – Sept
Total	**680**	**87**	**6**	**85**	**18**	**Jan – Sept**

In the past we provided both species of flies in separate deliveries to winter greenhouse cages, or two fly deliveries weekly per cage. Because of much fewer early wintertime greenhouse cages in comparison to previous years, and to maximize efficiency, we made single weekly deliveries of flies to winter greenhouse cages in 2010. Thus 2010 total fly delivery numbers appear lower than in previous years relative to little change in the total number of cages.

An average of 3 greenhouse cages received flies weekly from January through mid-April 2010. No flies were requested for greenhouse cages in the fall/early winter of 2010.

2010 Low, High, and Average Number of Cages/Accessions Supplied with Flies

2010 Season - FLIES	Winter	Spring	Summer	Fall
LOW number of cages/accessions	2/2	4/5	25/23	2/2
HIGH number of cages/accessions	4/5	14/12	59/58	23/23
AVERAGE number of cages/accessions	3/3	8/8	44/43	12/12

There were few changes in fly incubation or distribution protocols in 2010. Only blue bottle fly pupae were distributed weekly in winter and spring greenhouse cages due to few cages of umbels present; both blue bottle flies and houseflies were distributed weekly to summer field cages. Re-supplying flies weekly to cages ensures continued pollinator presence. If appropriate and available, bee pollinators may be present in the same cages receiving flies.

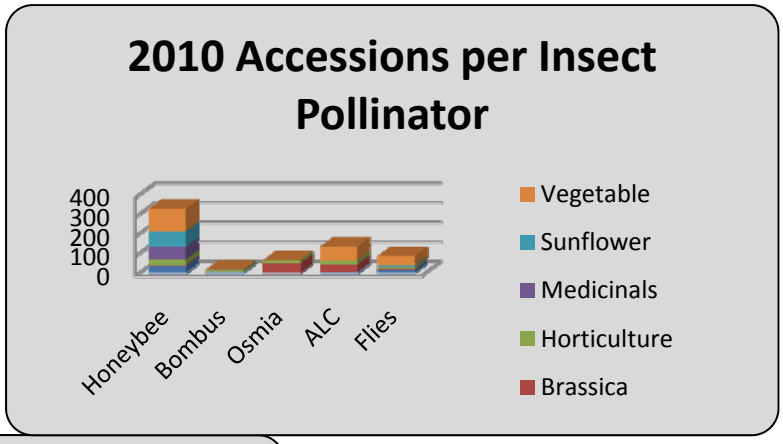
Summary of Pollinators supplied to regeneration cages in 2010

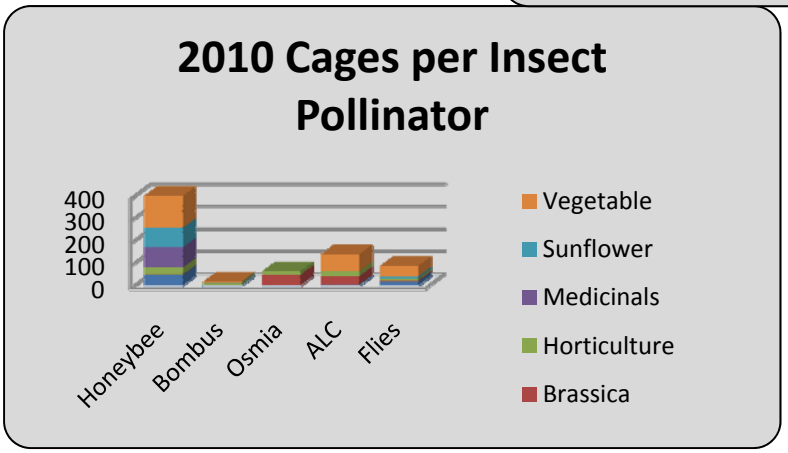
Number of Unique ACCESSIONS per pollinator

	Honeybee	Bombus	Osmia	Flies	ALC	TOTAL
Amaranth/MisUmb	33	2	1	14	3	53
Brassica	5	0	47	6	39	97
Horticulture	28	8	16	9	21	82
Medicinals	65	1	0	0	0	66
Sunflower	79	2	0	9	0	90
Vegetable	117	3	0	47	71	238
OVERALL	327	16	64	85	134	626

Number of TOTAL CAGES per pollinator

	Honeybee	Bombus	Osmia	Flies	ALC	TOTAL
Amaranth/MisUmb	48	3	1	17	4	73
Brassica	2	0	46	5	38	91
Horticulture	31	8	16	9	21	85
Medicinals	90	1	0	0	0	91
Sunflower	87	2	0	9	0	98
Vegetable	142	3	0	47	77	269
OVERALL	400	17	63	87	140	707





Pollinator Request database and Pocket Pollinator (McClurg):
No changes were made in the current version (3.4) of Pocket Pollinator in 2010. User errors still tend to occur when users unfamiliar with the PDA and program are attempting to make pollinator requests or where curatorial staff has not completed correct entry of lotcode or cage data into the NC7 Site-Inventory database prior to making cage labels and attempting to submit pollinator requests. In February, McClurg presented each curatorial project with a "Pocket Pollinator Pal," a 3-ring binder which contained revised hard copies of "Pocket Pollinator Protocols" as posted on the Entomology area of the NCRPIS SharePoint site in 2009. Other emphasis was placed on continued improvement/efficiency of entomologists' record keeping and improving written protocols.

Tests (Hanlin/McClurg):
Honey Bee Health (Hanlin):

Varroa mite (see ARS Photo by Scott Bauer to the right) counts were taken in May 2010 using both the sticky board and powdered sugar roll methods, and again in September using only the sugar roll. In the spring of 2010, the average mite counts with the sticky board method (which requires use of Apistan® strips (fluvalinate)) from 26 colonies were 12 mites per board. Because of documentation stating that mites have shown a high resistance to Apistan®, which can then result in decreased numbers of mites dropping onto the sticky board, it was decided to confirm mite populations using the sugar roll method as well. The sugar roll was used on 50% of the nucleus hives and colonies and produced an average mite count of 15 mites per 100 bees.

The difference in mite counts between the two sampling methods could have been due to: a) resistance to Apistan® demonstrated by reduced mite drop, or b) the addition of the nucleus hives and a larger number of colonies sampled with the sugar roll method, or may not be significant. Based on both sampling methods, the mite counts were below the economic injury level of 20 mites per colony and it was decided that no additional treatment would be administered in the spring of 2010. The original 26 colonies used in the sticky board method, however, were treated with Apistan® for a total of 6 weeks. In the fall of 2010, sugar roll sampling was repeated, and we found an average mite count of 20 mites per100 bees, lower than the recommended fall treatment threshold level of 30 mites per100 bees. But there were approximately 20% (12 colonies) with more than 30 mites per sample. Since no mite treatment had been applied in 2009, it was decided that it would be of benefit to treat all hives prior to preparing them for winter of 2010/2011. Starting in September 2010, two treatments of Apiguard® were applied at two-week intervals to all nucs and colonies to be over-wintered. Because of an adequate supply of Apiguard® on hand and manufacturer information that product integrity would be retained through 2011, we decided not to purchase Mite-Away® (formic acid) for 2010 use.

Use of multiple ALC domiciles and weekly bee distributions in *Cucumis* field cages in order to increase fruit production (McClurg):
In a 2009 field study, it appeared that weekly (new bees in regardless of a cage's ALC bee population) rather than normal (new bees in only at low ALC bee

population) distributions of ALC bees may increase fruit set in wild *Cucumis* regeneration cages. Numbers of domiciles per cage were not equal in this informal study, however, so it seemed important to compare four total treatments in a repeat field study in 2010. These four treatments were: 1) multiple (five domiciles/ cage) with normal bee resupply, 2) multiple domiciles with weekly bee resupply, 3) single domicile/cage with normal bee resupply, and 4) single domicile with weekly bee resupply.

These four treatments were applied to 44 2010 vegetable field regeneration cages. *Cucumis* is currently grown in both 5' tall and 7' tall cages, causing plants and pollinators to have potentially different interactions in the two cage sizes. 5' cages may become completely filled with foliage, which restricts pollinator movement, while 7' cages generally provide adequate space for vines/leaves and thus pollinators may move about freely. Thus an equal number of both 5' and 7' cage sizes were included in the *Cucumis* portion of the study. Although most ALC bees are used for accessions of *C. melo*, an equal number of *C. sativus* cages were included in the study for comparison. With the exception of selection for healthy vigorous plants at the study's initiation in July 2010, the 32 total *Cucumis* study cages were chosen randomly from the entire vegetable increase field plot. Since Vegetable Project personnel requested that a larger number of *Daucus* cages be primarily ALC bee pollinated this summer, 12 *Daucus* cages (all 7' tall) were also included in the study to determine if crops other than *Cucumis* would benefit from the weekly bee resupply rather than normal bee distribution.

ALC bee deliveries were made in this field study from 14 July to 9 September 2010. The 2010 growing season was very wet with several severe storms and the area's worst flooding since 1993; growing conditions were suboptimal for the vegetable crops in this study. The frequent heavy rains led to more ALC bee deliveries to the normal resupply treatment cages than may have occurred in a more typical year. On average, there didn't seem to be great differences in the number of ALC bee deliveries for each of the three crops for: 1) normal vs. weekly bee resupply, 2) multiple vs. single domiciles, 3) replications within genus/species, and 4) 5' vs. 7' cage sizes. When these four factors were all combined into 8 treatments for statistical analysis of bee deliveries to each of the three crops, the treatments were found to be significantly different, likely because there were more weekly bee deliveries than normal bee deliveries in all situations.

In addition to the weather impacts already noted, the number of bee deliveries was directly related to the length of pollination season of the different crops in the study. *Daucus,* which start blooming earliest, received an average of six bee deliveries in the 2010 field season, while *C. sativus* (which bloomed next) received an average of five deliveries and *C. melo* (which bloomed last) received an average of four bee deliveries.

Based on field observations in August-September 2010, the location of the ALC domiciles within *Cucumis* cages didn't appear to determine where fruit was formed within the cage, which was consistent with the 2009 plot. Overall, *C. sativus* tends to have fruit located along the length of the center of the cage due to the early presence of both male and female flowers, while *C. melo* tends to have fruit located

along the cage perimeter due to the later presence and flowering of female flowers compared to the male flowers (per K. Reitsma).

Statistical analysis of the number of fruits harvested showed that *C. sativus* alone was significantly different for replications and treatments where all factors were combined. There was more consistent fruit production in *C. sativus* cages (number of fruit/cage ranged from 4 to 111 with more cages in the 40 to 60 range) than there was in *C. melo* cages. One *C. melo* cage produced a very large number of very small fruit (368) in comparison to very modest numbers produced in other *C. melo* cages (ranging from 4 to 31 fruit of varying larger sizes). One note of interest was that it appeared that there was an increase in fruit production of both *Cucumis* species in the 7' tall cages versus fruit counts in 5' tall cages. As mentioned previously, vines/foliage are more dispersed in the larger 7' tall cages which exposes more flowers and makes it easier for pollinators to move about.

No seed count data for either *Cucumis* or *Daucus* were available at the time of this report. It is unknown whether testing a wider range of *C. melo* accessions (or other crops) will demonstrate the differences of using multiple domiciles and weekly bee releases on seed production vs. use of single domiciles and normal bee distributions, as in 2009 with a narrow scope of *C. melo* accessions.

Seed pests – Determine if red and/or gray sunflower seed weevils are present in perennial sunflower field plots and search for better control methods (McClurg):
Two complete field surveys were conducted for weevils during the 2010 growing season. Cage frames and screens were applied early in the field season which made scouting these plots more complicated. Observations were hindered further when many of the cages were destroyed during a severe storm in late July.

At the end of June, 8 of 24 plots had gray sunflower seed weevils weevil counts from 1 to 35. At the end of July, 12 of the plots had from 2 to 29 weevils of both red and gray sunflower seed weevils. The plot was sprayed after each survey.

It does not appear that the intensive spray program conducted during the 2009 field season significantly reduced overwintering weevil populations in these perennial plots in 2010 as was hoped.

Safety:
Chemical Inventory:
S. McClurg and S. Hanlin updated the Entomology chemical inventory in February 2010. As recommended by ISU EHS, inventory printouts were placed at the various chemical storage locations listing products stored at specific locations and quantities. S. McClurg compared the station MSDS list to the Entomology building MSDS notebook and updated it.

Bee yard maps/driving directions:
During NCRPIS first aid training sessions in 2009 - 2010, the importance of telling emergency responders how to reach your location was discussed. Because the bee yards are away from the station in rural/isolated areas, directions may be

complicated for personnel to relay off the top of their head. During fall of 2010, McClurg used Google Maps® /Google Earth® and established GPS coordinates of bee yards recorded by Hanlin to develop standard driving directions and detailed maps of all twelve bee yards currently or recently in use. Hanlin and crew verified these directions for accuracy. Sets of maps/directions were printed and laminated and placed for reference in the Station and Entomology offices.

Equipment:

Freeze Dryer:
Three separate curatorial projects made use of the lyophilization unit housed in the Entomology Building during summer 2010. S. McClurg provided documentation and training for use to new users prior to their work in June. Experienced users L. Marek, I. Larsen, and crew also used the unit for plant tissue capture for marker analysis. Clarifications were given by McClurg to all involved personnel on proper use procedures to ensure correct machine function.

The compressor malfunctioned in late summer and was serviced at Iowa State University, Ames per L. Marek's request. Limited use of the unit during fall 2010 showed that the repairs were successful.

McClurg reorganized and clearly labeled contents of storage units within the equipment room to accommodate new supplies for use with the liquid nitrogen tank, spare gaskets and other parts for the freeze dryer, safety and PPE equipment so that supplies could be easily found by others.

Presentations and Outreach:
5 January 2010, Hanlin was visited by S. Ruin (Kemin Industries, Des Moines, IA) regarding the use of *Osmia* and *Bombus* for greenhouse pollination of rosemary. Hanlin supplied Ruin with a list of commercial pollinator suppliers.

Using flies for pollination of row-covered crops was discussed with J. Kane (ARS Bee Lab, Logan, UT) by Hanlin/McClurg in January and March, 2010.

4 March 2010, W. Schmidt (Iowa beekeeper) and his wife were given a tour of the over-wintering facilities by S. Hanlin. Hanlin supplied photocopies of journal articles and design plans for "inside over-wintering of honey bees" to assist the Schmidts in designing their own over-wintering facilities.

6 March 2010, S. Hanlin gave a PowerPoint presentation on species of native *Bombus* of Iowa and general facts about bumble bees at the "Day of Insects" (theme "Iowa Prairie Insects"), held at Reiman Gardens, Ames, IA.

Input on fly vs. bee pollination of *Brassica* was provided to F. Forcella (ARS Soils Lab, Morris, MN) in April, 2010.

28 April 2010, ALC bee reference information was provided to R. Palmer, CICG, Ames, by McClurg.

21 May 2010, J. McVey an 8th grader from Ames Middle School, shadowed S. Hanlin. McVey assisted in setting up *Osmia* domiciles in cages, making nucleus hives and finding queens in both nucs and colonies, and toured the station.

28 May 2010 Hanlin and McClurg visited with Alfredo Alves (EMBRAPA) regarding the Entomology project and pollinators used here.

6 June 2010, Hanlin spoke at "Buggy about Plants" held at the Des Moines Botanical and Environmental Center. Hanlin showed specimens of different pollinators, a honey bee observation hive and answered questions on different native pollinators possibly found in peoples' gardens and backyards.

7 June 2010, McClurg provided to P. Bretting, National Program Staff (via P. Cyr) the 2009 Powerpoint presentation for GRIN Global and Word documents outlining basic use protocols for Pocket Pollinator. This information was to be shared ultimately with U.K. National Fruit Collection personnel interested in our barcoded data collection system.

18 June 2010, McClurg provided J. Dyer (CICG, Ames) with corn earworm rearing references.

24 June 2010 Hanlin and McClurg visited with Pablo Jordan (OPGC director) regarding the Entomology project and pollinators used here.

21 July 2010 Hanlin acted as coordinator for six other NCRPIS staff members (McClurg, Burke, Erickson, Lockhart, Lively, Reitsma) who hosted a group of 12 high school students and 4 adult counselor/faculty sponsors participating in the USDA Ag Discovery program during a 4-hour station visit. They learned how to pollinate corn and pumpkins and heard about the diversity of pollinators used at the station. They had the option to put on protective clothing and work hands-on with honey bee nucleus hives with Hanlin/bee crew or discussed handouts on "alternate pollinators" and questions about the station and pollinators with McClurg.

6 Aug 2010 McClurg gave the PI pollinator presentation to 2 people who were in attendance at the North American Prairie Conference at UNI earlier in the week.

14 October 2010, S. Hanlin spent the day talking to 240 seventh-grade students at Ames Middle School in five 45-minute sessions. Hanlin spoke about general honey beekeeping information including the castes of honey bees, equipment used, and the pros and cons of honey bees. Hanlin finished each session by answering questions and letting the students try on equipment and look at the observation hive.

December 2010, Hanlin and McClurg provided information and a honey bee photo opportunity to two ISU students (K. Cooper and classmate) studying the effect of Colony Collapse Disorder on insect pollinators.

Several times during 2010, S. Hanlin was contacted by D. Peterson of the North Central Soil Conservation Research Lab in Morris, MN inquiring about the purchasing and emergence of fly pollinators for *Cuphea* pollination.

A. Toth of ISU, Ames requested NCRPIS assistance with paper wasp nesting sites (set aside due to safety concerns) and a possible comparative study of pollinator larvae, April and June, 2010.

Plans for 2011:

Use of formic acid for mite control (Hanlin):

For the past three years we have utilized Apiguard® (thymol) gel or one of two brands of chemically impregnated mite strips (Apistan® or ChekMite®) for Varroa mite control. In the last five years, the Varroa mite has shown an increasing resistance to the mite strips, so we chose to use Apiguard® as our only control for mites. To possibly reduce resistance buildup of the mites to the Apiguard® thymol, we plan to purchase Mite-away® (formic acid) or alternative treatment for mite control in 2011. Mite-away® is introduced in a single treatment as a chemically impregnated pad which is placed on brood frames to control both Varroa and tracheal mites. Hanlin plans to stop use Apiguard® and Mite-away® together.

Wax moth control in stored honey bee supers (Hanlin):

With the success of the non-chemical, revised methods used in 2009/2010 for wax moth control, we will continue to store supers of frames via the two methods mentioned in VII-A, use fermentation traps near the stacks of supers in order to monitor adult moths, and leave the lights on during working hours in the storage area. We may try several other non-chemical controls such as the use of a "bug zapper" and the use of LED lights rather than incandescent light bulbs. The added year of study would be used to verify if our non-chemical control methods are working well enough to eliminate the use of Para-moth® (para-dichlorobenzene) crystals.

2010 data follow-ups (McClurg):

Once seed data are provided by curatorial staff for the 2010 sunflower and vegetable increase cages, McClurg will complete analysis of the ALC multiple domicile/ weekly vs. normal bee release study and the red-gray sunflower seed weevil surveys.

B. Plant Pathology (C. Block, B. Van Roekel)

Research Activities:

Maize:

Field trials included 259 maize accessions screened for resistance to Stewart's wilt, caused by *Pantoea stewartii* ssp. *Stewartii*, including 38 newly-available GEM lines and 75 newly-released PVP lines. Five highly resistant accessions are shown in Table 1 along with one susceptible inbred for comparison. Both 2009 and 2010 data are shown if available. A score of $\leq$2.0 indicates highly resistant germplasm, and 1.0 means that essentially no disease developed. A high level of northern corn leaf blight (NLB), caused by *Exserohilum*

turcicum, also developed in August. Accessions were rated for NLB resistance on a 0-5 scale of R to S, with several accessions showing no infection.

Table 1. Stewart's wilt and NLB resistance of selected inbreds from 2009/10.

Entry	Alternate ID	Other notes	2009 SW average score (1-9 scale of R to S)	2010 SW average score (1-9 scale of R to S)	NLB rating (0-5 scale of R to S) -2010
PI 558533	Mo21R	Resistant to northern corn leaf blight - *Exserohilum turcicum*.	1.0	1.0	0.0
Ames 26754	WXL317	Inbred L317 crossed with waxy gene donor.	1.1	1.4	0.7
Ames 26803	H113	Yellow corn inbred, Purdue Univ.	1.3	1.1	0.7
PI 600956	MDF-13D	Yellow corn inbred similar to Mo17. Expired Dekalb PVP.	1.1	1.1	0.0
PI 601689	WIL500	Developed by Wilson Hybrids from tropical germplasm population.	not tested	1.0	0.0
Ames 23507	C42	Yellow corn; Golden Bantam parentage.	8.2	9.0	NR

In a second test plot, 36 maize inbreds of known Stewart's wilt response were tested for resistance to Goss's wilt, caused by *Clavibacter michiganensis* ssp. *nebraskensis*, to see if reactions to the two bacterial diseases were similar. This may allow one to predict Goss's wilt resistance from Stewart's wilt data. Table 2 shows reactions of five top accessions and one susceptible check along with their corresponding Stewart's wilt ratings.

Table 2. Goss's wilt resistance of selected inbreds from 2010.

Entry	Alternate ID	Other notes	Average SW score (1-9 scale of resistant to susceptible)	Average Goss's score (1-9 scale of resistant to susceptible)
Ames 27193	Va85	Highly resistant to Stewart's wilt.	2.0	1.0
PI 558533	MO 21R	Highly resistant to Stewart's wilt.	1.3	1.0
Ames 25559	H60	Highly resistant to Stewart's wilt.	1.6	1.1
PI 601037	G80	Highly resistant to Stewart's wilt.	1.8	1.1
Ames 26121	CI 28	Highly resistant to Stewart's wilt.	1.7	1.2
Ames 20140	C42	Highly susceptible to Stewart's wilt.	8.2	8.2

We conducted a seed transmission grow-out study with two Goss's wilt-infected maize seed lots. No seed transmission was found from 2,200 plants tested. We found one positive case from 3,990 plants in earlier grow-outs. Seed transmission is an extremely rare event, but getting one more positive would allow a better estimate of the true transmission rate.

Sunflower disease resistance:
We conducted greenhouse and field evaluations for Sclerotinia stalk rot resistance, with co-investigators Dr. Thomas Gulya of Fargo, ND and Dr. Laura Marek at Ames. In 2010, 150 wild sunflower accessions were screened in the greenhouse. This included annual species of *Helianthus agrestis* (3 acc.), *H. annuus* (60 acc.), *H. argophyllus* (1 acc.), *H. anomalus* (4 acc.), *H. bolanderi* (5 acc.), *H. deserticola* (10 acc.), and *H. paradoxus* (2 acc.). *Helianthus agrestis* was impressive, with only one dead plant among 176 total, but *H. agrestis* does not cross with *H. annuus*. The other annual species were fairly susceptible and, except for three moderately resistant *H. deserticola* accessions, showed little merit in terms of further evaluation. We evaluated 60 wild *H. annuus* accessions to determine if a particular geographic region (from ND to south Texas) might have a sufficiently high percentage of resistant germplasm to warrant further screening of accessions from the same region. Six of the top 10 accessions originated from south Texas, but none was superior to the resistant hybrid check, Croplan 305. All perennial species showed remarkable resistance, including *H californicus*, *pauciflorus*, *resinosus*, and *salicifolius*. All 10 *H. californicus* accessions had better than 95% plant survival and seven had 100% plant survival. Twenty-two of the 31 *H. pauciflorus* accessions had ≥80% plant survival. For *H. resinosus*, 8 of 14 accessions had 100% survival and 11 were ≥ 90%. For *H. salicifolius*, 7 of 14 accessions had 100% survival and 12 were ≥ 90%. *Helianthus salicifolius* is diploid and the other three species are hexaploid. Twenty-seven entries were planted in a field trial at Staples, MN along with F1 crosses of the susceptible inbred HA89 with *H. argophyllus*, *H. petiolaris* and *H. praecox*. Unfortunately, frequent heavy rains severely limited Sclerotinia disease development, making it impossible to verify differences between susceptible and resistant lines.

Disease observations on seed increase crops:
Maize:
The pathology team inspected 320 accessions and 2,280 rows (maize curation) for diseases present and severity when present. Thirteen corn diseases were covered and 1,920 pathogen records were added to GRIN. Similarly, 875 entries of GEM lines (1,640 rows) were inspected for the same diseases, with the data summarized for the GEM project. Stewart's wilt was absent, as were Goss's wilt, head smut, crazy top, sorghum downy mildew, southern leaf blight, carbonum leaf spot, and virus symptoms. Northern corn leaf blight, caused by *Exserohilum turcicum*, was present at higher-than-normal levels, likely related to substantial rainfall. Five hundred laboratory tests were run on 200 maize seed lots, 88% for maize curation and 12% for GEM.

Cucumbers and melons (*Cucumis*):
We tested 237 older (1987 to 2002) *Cucumis melo* seed lots for bacterial fruit blotch (BFB) contamination by growing out seedlings under high humidity and temperature conditions in greenhouse isolation. One infected seed lot was identified.

Multiple disease inspections were conducted on 105 cucurbit cages. Due to excessive rain, regular copper fungicide applications were made for powdery mildew and anthracnose control. Gummy stem blight (*Didymella bryoni*ae) was identified in one hill of one melon accession, the first ever observed at Ames. The hill was removed and no further disease developed. No BFB was found in the 2010 plots and none has been found since 2004. Disease observations from field notes for 1988, 1990, 1991, 1994, 1996, 2006, 2007, 2008 and 2009 were reviewed, summarized and added to GRIN – 6757 pathogen records.

Cucurbit virus-testing:
Routine disease testing for squash mosaic virus was conducted on all seedlings prior to transplanting. All seedlings were tested by laboratory ELISA. One hundred and four accessions with 2,534 plants were sampled with one SqMV-infected plant found. Results are summarized in Table 1.

Table 1: Squash mosaic virus testing results for 2010

Species	Accessions tested	Accessions with infected plants	Plants tested	# of SqMV infected plants
Cucumis spp. (*melo, sativus, misc.)*	83	0	2287	0
Cucurbita pepo	11	1	247	1
Total	**104**	**1**	**2534**	**1**

Sunflower:
Multiple field inspections of sunflower (~600 rows) were carried out for downy mildew, viruses, and phytoplasmas. The seed increase plants were relatively free from diseases except for Alternaria leaf blight. No unusual diseases were noted.

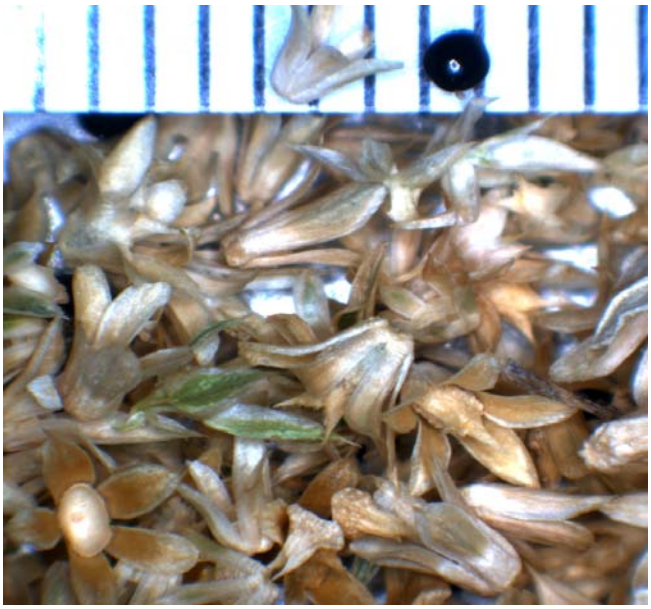
Publications:

Peer-reviewed:
Wechter, P., Levi, A., Ling, K-S, Kousik, C., Block C. 2011. Identification of resistance to *Acidovorax avenae* subsp. *citrulli* among melon (*Cucumis* spp.) Plant Introductions. HortScience. 46(2):207-212.

C. *Amaranthus, Celosia, Chenopodium, Coronilla, Dalea, Echinochloa, Galega, Marina, Melilotus, Panicum, Perilla, Setaria, Spinacia* and miscellaneous Apiaceae and Poaceae (D. Brenner and S. Flomo)

Acquisition and inactivation:
Twenty accessions were acquired (Table 1), including *Amaranthus*, *Dalea*, *Gomphrena* and allied genera, *Monolepis*, *Panicum*, and 9 miscellaneous Apiaceae.

Four new *Amaranthus* accessions, Ames 30694 to 30697, were collected by David Brenner and Susan Stieve (OPGC) during a PEO-sponsored plant exploration in Arizona. They include two species that are new to the collection, *A. torreyi* and *A.* ×*tucsonensis*. The *A.* ×*tucsonensis* accession is especially interesting since it is a newly described species that appears to be closely related to the cultivated grain species. The *A. fimbriatus* (Ames 30694) and *A. hybridus* (Ames 30695) collections represent species that were already in our collection. However this *A. hybridus* is unusual because it was in an undisturbed grassland, since it is generally a weed. An accession of *Gomphrena sonorae* (Ames 30705) and another from a related genus *Guilleminea densa* (Ames 30706) are both new species for the collection. A wild *Panicum hirticaule* (Ames 30709) was collected as a counterpart to our domesticated millet accession of the same species. Altogether, 34 accessions were collected in Arizona on this exploration, but most were for other curators and other germplasm stations.



Close-up of *Amaranthus* ×*tucsonensis* (Ames 30697) fruits (1 mm ruler marks). The presence of five tepals suggests a close relation to the grain amaranths since other sections of the genus have three tepals.

Collecting *Gomphrena sonorae* (Ames 30705) in Arizona.

Three accessions of *Monolepis nuttalliana* (Ames 30538-30540), a spinach relative, were donated this spring by Grace Costel of Black Hills State University, from new collections in western Nebraska and western South Dakota.

An accession of *Dalea gattingeri* (Ames 30479) was donated by Garold Mahan in MO. The plants are native, attractive, and perhaps suitable for use as ornamentals.

Seven new Apiaceae accessions were donated in four groups. An accession of *Eryngium foetidum* (Ames 20513) used for flavoring in Puerto Rico was collected by Brian Irish (TARS). Four wild-collected accessions (Ames 30666-30669) of un-identified umbels were collected in California by David Spooner and Philip Simon of the USDA/ARS. A native prairie species, *Zizia aurea* (Ames 30692), was donated by Andrew Thomas of the University of Missouri. And a wild-naturalized *Foeniculum vulgare* was donated from Eugene, Oregon by Scott Root.

David Brenner collected two accessions of ramp (*Allium tricoccum*) in Iowa for the *Allium* collection in Pullman, Washington.

Maintenance and distribution:
For 9 of the12 site-crops curated by this team, the number of orders in 2010 was lower than in 2009 (Table 5), so this year was similar to years prior to 2009. I attribute this reduction to fewer orders from home gardeners.

The number of accessions of these crops tested for germination (table 2), 225 (2.5%) is lower than the 7% tested in 2009. Numbers fluctuate depending on station priorities, labor availability, inventory lot age, and normal scheduling variations.

Amaranthus:
There was no *Amaranthus* field planting in 2010 for the first time in at least 25 years. Steady rains during the planting window forced postponement and then cancelation of the field season.

A December greenhouse planting was harvested in early 2011. Most of the accessions were grown to replace open-pollinated distribution seed lots from 1983 with new control-pollinated seed lots.

Chenopodium:
The *Chenopodium* seed orders were up from 57 in 2009 to 63 in 2010, reflecting good press about quinoa's health benefits and short commercial supplies. Introduction projects and systematics projects utilize our germplasm. A project in Pakistan reported success with fall-planted quinoa.

Melilotus:
In late February, voles destroyed many *Melilotus* seedlings in Farm Greenhouse-2. We moved the plants onto tables which solved the problem since voles seem unable to climb table legs.

Caterpillars of clouded sulfur butterflies (*Colias philodice*), as determined by Sharon McClurg, were a pest problem on *Melilotus* accessions in field cages during the summer and were controlled with standard pesticides.

Twenty-nine *Melilotus* accessions were harvested in 2010. Twenty-eight accessions were planted in our cool greenhouse (Farm Greenhouse 2) in October 2010 for spring transplanting into the field. They will be pollinated with caged bees and harvested in mid 2011.

Millets:
A large repatriation order of 103 accessions, mostly of *Setaria*, was shipped to Taiwan in December 2010. The germplasm was collected in remote villages there in 1977, and was subsequently lost at the original locations. Prof. Warren H.J. Kuo of the National Taiwan University is coordinating the germplasm reintroduction.

Miscellaneous Umbelliferae:
We conducted an experiment on *Petroselinum* (parsley) vernalization. We planted an accession that had vernalized poorly (NSL 42902) on July 15, rather than in October, as had been done previously. They grew in small 12-cm deep rootrainer cells and were then vernalized in our cool greenhouse with night temperatures at ca. 8°C followed by 43 days in a 4°C growth chamber, and transplanting into the field on April 14. Under these conditions vernalization was completely effective. By planting earlier, we can improve vernalization even in small space-efficient pots. We plan to replicate this with more accessions in 2011, since it would be an improvement on both our poor vernalization from October plantings, and on 2008 field plantings which vernalized well but required large pots in the winter to contain the large, field-grown plants.

Our NPGS colleagues in Parlier, California regenerated 8 *Petroselinum* accessions.

We regenerated 18 accessions of nine Umbeliferae genera in 2010. Some were not identified to genus at the time of planting, but were then determined during the growth season and regeneration process.

Spinacia and allied genera:
One-hundred-sixteen seed lots of *Spinacia* were stored in 2010, resulting in an increase in availability from 86 to 97 percent.

We had no regeneration planting in Salinas in 2010, since regenerations of cultivated spinach are current. We continued to regenerate wild species in greenhouses at the NCRPIS.

Our first *Monolepis nuttalliana* accession (PI 658757) has been regenerated, is available for distribution, and was distributed five times in 2010.

Characterization/evaluation/taxonomy:
Improving passport data was a priority in 2010.

A major image loading effort by Samuel Flomo resulted in images loaded to the GRIN database for 712 accessions, making important progress against a significant backlog.

The International Rice Research Institute (IRRI) georeferenced a significant subset of the accession data in the GRIN database, generating new latitude and longitude coordinates and confidence-interval estimates. They also fixed data entry errors such as incorrect use of data fields. IRRI data were checked and loaded for 1,026 accessions, primarily in the genera *Echinochloa*, *Panicum*, and *Setaria*. Approximately 2,000 accessions in the genera assigned to Brenner have data yet to be verified and possibly loaded. David Brenner also made significant passport data improvements to 456 accessions beyond the IRRI data. These changes include entering data in GRIN for 430 accessions that were donated by the University of Illinois, Crop Evolution Laboratory during the 1980s. The Crop Evolution Lab passport data revealed 17 new examples of duplication between accessions.

Evaluation data on 80 *Setaria* accessions were returned to us by Jiří Hermuth at Praha Ruzyně in the Czech Republic. His observations on height, adaptation, and seed maturity before winter were loaded into GRIN. It is unusual for cooperators to return data formatted in a manner that is so well suited for GRIN.

Fall Establishment of *Melilotus* Pilot Study:

Thirty-two accessions of *Melilotus* were planted in 1.5 m (5ft) rows in August 2009. The plants established well and 28 accessions survived the winter well. Even four of the summer annual accessions, including 'Hubam' (PI 478772) and 'Israel' (PI 593235), survived the winter; apparently they can adapt to winter conditions. A thick and constant snow cover may have favored survival that winter. The accessions that failed to survive the winter were winter-annuals such as *Melilotus indicus*. We were encouraged by members of the Clover CGC to make similar plantings in mid-September 2011 to find out which accessions are best suited for fall plantings. The intention is to find accessions that have special adaptation for establishment from late-season plantings, desirable for cover crop use.

Melilotus plants that over-wintered in the field had substantial growth by April 21, 2010.

Taxonomy:
In 2010, David Brenner made 40 taxonomic changes, involving eight different genera, including 11 *Amaranthus*, 13 *Orlaya,* and 9 *Setaria.* The *Orlaya* re-identifications were previously misidentified as *Caucalis* and were verified with a field grow-out of 20 accessions in coordination with systematic studies of *Daucus* by David Spooner. *Orlaya* appears to be closely related to *Daucus.* In addition, eight existing taxonomic determinations were confirmed and entered in GRIN's Annotation area.

Enhancement and/or utilization:
We released a new line of *Amaranthus cruentus* (DB 2006306) via Iowa State University in early 2010 (http://www.agron.iastate.edu/cad/amaranth.html). It produces white seeds on all-green plants, and otherwise resembles the African Vegetable Type. The consumers already use black-seeded forms of the African Vegetable Type, and may find this white-seeded form useful as a multipurpose crop for grain and greens. The AVRDC World Vegetable Center in Tanzania is interesting in evaluating this germplasm and has received seed samples.

Publications and presentations:
Presentations:
David Brenner participated in VEISHEA (Iowa State University festival) presentation of fragrant seeds in the Agronomy display tent. Visitors were challenged to identify unknown spice-seed samples in a sniffing quiz format that he developed from several years of elementary school presentations of the same material. In 2010, the presentation was modified by Rachael Beyer, Lucinda Clark, Trent Moore, Robert Stebbins, and others for NCRPIS use.

Conferences attended:
March 2-4, 2010. Midwest Cover Crop Council, Ames, IA
October 31 to November 3, 2010. American Society of Agronomy, Long Beach, CA

Crop Germplasm Committee reports:
Written progress reports were prepared for the Clover and Special Purpose Legumes, Forage and Turf Grass, Leafy Vegetable, and New Crops Crop Germplasm Committees (CGCs). Reports were presented personally at the Clover and Special Purpose Legumes and Forage and Turf Grass CGC meetings in Long Beach, CA.

Visitors:
April 26 to May 1 2010, David Wu, Curator for Indigenous Vegetables and *Amaranthus* at the AVRDC in Taiwan, visited the NCRPIS. The AVRDC is building capacity for *Amaranthus* taxonomy and breeding.

Professional society participation:
In August 2009, David Brenner was elected President of the Amaranth Institute by its Board of Directors. The term continued in 2010.

Some research publications derived from use of our germplasm or associated information:

Graham, M.W. 2010 Grain amaranth production and effects of soil amendments in Uganda. Iowa State University, MS Thesis.

Hirsch, Ann M., Angie Lee, Weimin Deng, and Shirley C. Tucker. 2010. An open flowered mutant of *Melilotus alba*: potential for floral-dip transformation of a papilionoid legume with a short life cycle? Amer J Bot 97(3): 395-404.

Hunt, Harriet V., Kay Denyer, Len C. Packman, Martin K. Jones, and Christopher J. Howe. 2010. Molecular basis of the waxy endosperm starch phenotype in broomcorn millet (*Panicum miliaceum* L.) Mol. Biol. Evol. 27:1478–1494.

Kovach, D.A., Widrlechner, M.P. and Brenner, D.M. (2010). Variation in seed dormancy in *Echinochloa* and the development of a standard protocol for germination testing. Seed Sci. & Technol., 38, 559-571.

Lyon, D.J., P.A. Burgener, K.L. DeBoer, R.M. Harveson, G.L. Hein, G.W. Hergert, T.L. Holman, L.A. Nelson, J.J. Johnson, T. Nleya, J.M. Krall, D.C. Nielsen, and M.F. Vigil. 2008. Producing and Marketing Proso Millet in the High Plains (EC137). University of Nebraska Extension Publications.

Munir H. 2010. Introduction and assessment of quinoa (*Chenopodium quinoa* Willd.) as a potential climate proof grain crop. University of Agriculture, Faisalabad, Pakistan. Ph.D. dissertation.

Munir H. and Basra S.M.A. 2010. Improved germination and seedling vigor enhancement of quinoa (*Chenopodium quinoa* Willd.) grown at different salinity levels**.** In: Qadir M., Wichelns D., oster J., Jacobsen S.-E., Basra S.M.A. and Choukr-Allah R. (eds.). Sustainable managment of saline waters and salt affected soils for agriculture: Proceedings of the 2nd bridging workshop, 15-18 Nov., 2009, Aleppo, Syira. International Center for Agricultural Research in the Dry Areas, (ICARDA), Aleppo, Syria; and International Water Management Institute (IWMI), Colombo, Sri Lanka. pp 33-39.

Park, Young-Jun, Kazuhiro Nemoto, Tomotaro Nishikawa, Kenichi Matsushima, Mineo Minami, Makoto Kawase. 2010. Waxy strains of three amaranth grains raised by different mutations in the coding region. Molecular Breeding 25**:**623-635**.**

Yerka, Melinda D. Stoltenberg, N. De Leon, 2010 The role of gene flow in the spread of *Chenopodium album* resistance to herbicides. 295-3 Abstract and oral presentation at ASA Annual Meeting Long Beach CA Oct 31-Nov 3.

Young-Jun Park, Kazuhiro Nemoto, Tomotaro Nishikawa, Kenichi Matsushima, Mineo Minami and Makoto Kawase. 2009. Molecular cloning and characterization of granule bound starch synthase I cDNA from a grain amaranth (*Amaranthus cruentus* L.). Breed. Sci. 59:351-360.

Verma, N., M.K. Rana, K.S. Negi, G. Kumar, K.V. Bhat. Y.J. Park, I.S. Bisht. 2010. Assessment of genetic diversity in Indian perilla [*Perilla frutescens* (L.) Britton] landraces using STMS markers. Indian Journal of Biotechnology 9:43-39.

Research indirectly related to our germplasm:
Brutnell, Thomas P., Lin Wang, Kerry Swartwood, Alexander Goldschmidt, David Jackson, Xin-Guang Zhu, Elizabeth Kellogg, and Joyce Van Eck. *2010. Setaria viridis*: A model for C_4 photosynthesis. Plant Cell 22: 2537-2544.

Chakrabortya, S., N. Chakrabortya, L. Agrawala, S. Ghosha, K. Narulaa, S. Shekhara, P. S. Naikb, P. C. Pandec, S.K. Chakrbortib, and A. Dattaa. 2010. Next-generation protein-rich potato expressing the seed protein gene AmA1 is a result of proteome rebalancing in transgenic tuber. Proceedings of the National Academy of Science (USA) 107:17533-17538.

Morelock, T.E., and J.C. Correll. 2008. Spinach. p. 189-218. *In* J.Prohens and F. Nuez. (ed.) Vegetables I. Handbook of plant breeding. Springer. NY.

Swain, S.S, S.D. Lopamudra, P.B. Pradeep, K. Chand. 2010. Agrobacterium×plant factors influencing transformation of 'Joseph's coat' (*Amaranthus tricolor* L.) Scientia Horticulturae 125:461-468.

Plans for 2011:
We will host the Amaranth Institute meeting in October 2011, in Ames, IA.

We plan to continue enriching the GRIN database with new information, loading images, passport data, and observations. For example, bibliographic citations will be loaded into the GRIN citation field. Public GRIN presentation and searching of citations has improved. Also we are documenting accession-area loads in the GRIN accession actions, so that those activities can be summarized easily for reports.

D. Horticulture (M. Widrlechner, J. Carstens)

Acquisition:
During 2010, we worked with Robert Stebbins to enter information for 109 new accessions of ornamentals and mint-family plants into the GRIN database (Table 1). The largest group of these accessions comprised samples of *Fraxinus*; most were collected in Minnesota, Wisconsin, and the Ozarks by Jeff Carstens (along with STEP Matt O'Hearn in the Ozarks) and collaborators, including Egon Humenberger (University of Minnesota – Grand Rapids). Other important collections included samples of wild populations of *Aronia* (many collected and donated by Mark Brand, Univ. of Connecticut) and of *Gymnocladus* (Kentucky coffeetree), collected in collaboration with Andy Schmitz of the Brenton Arboretum, who is assembling comprehensive collections of this genus with plans for eventual recognition through the North American Plant Collection Consortium.

Plans for the acquisition of *Fraxinus* germplasm from both North America and northeastern Asia moved forward with some urgency in the face of the destruction of

native ash populations by the continuing spread of Emerald Ash Borer, which has now been detected in Iowa. As part of the process to assemble representative *Fraxinus* collections, the USDA-ARS Plant Exchange Office supported reconnaissance and collection trips to eastern Minnesota and Wisconsin and a collection trip to the Ozarks, and our plans for future explorations in China continued with the Beijing Botanic Garden. In March 2010, Mark Widrlechner and Jeff Carstens attended an ash symposium at Purdue University and discussed upcoming collection plans. With considerable assistance from David Kovach, Mark and Jeff also created an NPGS ash conservation webpage with guidelines for ash seed collection and documentation, http://www.ars.usda.gov/sp2UserFiles/Place/36251200/Ash_Project/HomePage.html. We gained considerable publicity about our ash seed conservation efforts through national media and four presentations that Mark gave during the year (details on page 55.

Maintenance:
Maintenance efforts continued in 2010 emphasizing the regeneration of shrubs in cages. This was the fourth year for two cage fields for woody shrubs, one, including 46 accessions, focused on *Cornus*, *Rhus*, *Ligustrum*, *Staphylea*, *Aronia*, and *Physocarpus*, and the other used larger, hoop-house cages for *Cornus alternifolia* and *Rhus typhina.* These hoop houses suffered significant storm damage in July 2010 (as illustrated on following page), but good harvests could still be made. Additional efforts resulted in the establishment and regeneration of 14 accessions of *Calendula.* Fifteen newly obtained, vegetatively regenerated *Aronia* accessions were added to the existing field of *Aronia* populations received from Mark Brand. Forty *Aronia* accessions are now in queue for regeneration in 2011.

Damage to hoop houses caused by windstorm on 17 July 2010. Fortunately, all pollinations were complete and good seed harvests could be salvaged.

Experiments to determine the effects of paclobutrozol in reducing height and potentially hastening flowering of *Rhus typhina* and *Fraxinus* continued. Applications on ½" caliper specimens of *Rhus* produced extremely stunted leaves,

shortened internodes, and darkened green leaves. Applications made in 2009 did not result in changes until the spring of 2010. Plants began to resume normal growth in early June, 2010. A second application in mid-June immediately resulted in a growth response resembling that noted in early spring. Applications of paclobutrozol on *Rhus* specimens greater than 1" caliper showed no response to treatments. Some plant death was observed on small *Fraxinus* seedlings (4" tall) treated at the highest rate (120mL in 9.47L of water) about one year after application, while the control and lower rates displayed little mortality. All rates showed similar symptoms of stunted growth.

The horticulture crew continues to mulch long-term field plantings in order to increase plant growth and reduce the time and labor needed for mowing and weeding. A new piece of equipment (Reigi Weeder) was purchased in 2010 to help cultivate liner rows and observation plots, which should reduce herbicide applications and the time spent hoeing between plants within rows.

Availability:
During 2010, approximately 46% of the ornamental collections and 74% of the mint-family plants were available for distribution (Table 1), figures just slightly above those reported in 2009 (46 and 70%).

Regeneration:
Regeneration efforts in 2010 focused on established, caged shrubs, on seed germination for future regeneration cycles, and on caged *Calendula* accessions. The harvests listed in Table 2 include 59 cage increases of shrubs and herbaceous perennials and 11 woody-ornamental seed increases from isolation. There were also 34 accessions of woody plants established from seeds and 28 accessions vegetatively re-propagated. Through these activities and those from the previous year, along with efforts to obtain large, original seed samples, 98 accessions were made available for distribution in 2010 (Table 2).

Viability Testing:
In 2010, seedlots of 118 accessions were tested for germination (Table 2). This included the completion of tests initiated late in 2009, periodic re-tests for stored distribution lots, and new tests on bulked samples. We also conducted cut-tests of more than 400 lots of newly received *Fraxinus* seeds to assess initial quality.

Back-up:
Approximately 41% of the ornamental collections and 76% of the mint-family plants are duplicated at NCGRP (Table 2), figures slightly above those reported in 2009 (40% and 74%). Routine back-ups of dormant *Salix* buds with the National Center for Genetic Resources Preservation in Fort Collins, CO are now underway, and a new round of *Salix* samples were taken in early December and shipped to Fort Collins. This was completed at an earlier time in the winter than done in the past and should avoid any potential dehardening events.

Distribution:
As summarized below (and in Table 3), requests for accessions of ornamental germplasm returned to more typical levels in 2010, well below the unusually busy year of 2009. The 301 "order items" included all plant shipments for the NC7 Trials (described in the following section), along with 14 plants, 142 cuttings, 20 budwood sticks, and 271 seed packets, distributed to fulfill external requests for ornamental plant germplasm. This group encompassed 58 genera; those most in demand were *Solenostemon* (117 cuttings), *Calendula* (28 packets), *Fraxinus* (7 packets and 20 budwood sticks), *Baptisia* (22 packets), and *Sanvitalia* (21 packets).

Demand for mint-family germplasm also returned to "normal" in 2010.

Historical Summary of External Distribution Activity:

Crop	Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Ornamentals	06	89	76	436	322
	07	75	71	268	196
	08	92	83	352	249
	09	110	95	607	390
	10	**82**	**73**	**301**	**248**
Mint Family	06	19	19	55	37
	07	10	10	54	47
	08	14	14	88	64
	09	33	31	179	92
	10	**22**	**22**	**54**	**34**

Characterization/taxonomy:
All of the herbaceous ornamentals in the cage fields and many of the tree and shrub accessions being regenerated were checked to verify identifications, and past records were checked as part of the PI-numbering process. In all, 1 mint-family and 8 ornamental accessions were re-identified, and 13 accessions of ornamentals and mints received PI numbers. During 2010, Lisa Pfiffner captured seed images of 111 ornamental and mint-family accessions for our local database, and Jeff Carstens imaged an additional 25 accessions. These are named following our standard protocol. In 2010, 89 images were loaded to GRIN, by using the mass-loading system for images developed by Pete Cyr (Table 4).

Evaluation:
Evaluations reported in the 2008 NCRPIS Annual Report are ongoing for two ornamental shrub genera curated in our project: *Aronia* and *Spiraea*. In 2010, Dr. Mark Brand (Univ. of CT) conducted an AFLP analysis of the *Aronia* (chokeberry) cultivar 'Viking' suggesting that it is likely an F_2 hybrid involving *Sorbus aucuparia*. A manuscript detailing this work is in preparation. Biochemical analysis of over 30 wild accessions of black/purple chokeberry fruits has shown that some genotypes possess antioxidant activity levels, as measured by Oxygen Radical Absorbance Capacity (ORAC), phenolics, and anthocyanins, that are nearly twice those found in the most common commercial cultivar, 'Viking'. These genotypes may prove to be

valuable *per se*, or they could be useful in breeding programs to develop new, superior chokeberry cultivars. Dr. Mike Mickelbart's laboratory at Purdue Univ. has completed evaluations of light requirements and pruning regimens on the form and landscape performance of *Spiraea alba* and *tomentosa*, leading to the publication of two papers on those topics in 2010. Data have also been collected on the responses of these *Spiraea* accessions to water stress, and research is ongoing on the effects of various soil and media pH levels under field and container cultivation.

Enhancement:
There was no major progress to report with enhancement activities in 2010. One small, long-term project to conduct recurrent selection on *Fraxinus ornus* (flowering ash) for improved winter survival continued with the cultivation of a seedling population (Ames 29231) produced from trees selected in Urbana, IL. At the end of 2010, all of the 47 seedlings planted in 2008 at the NCRPIS farm were surviving and showed varying degrees of winter injury.

Coordination of the NC-7 Regional Ornamental Trials:
Plant Distribution - In 2010, Mark Widrlechner and Jeff Carstens distributed 159 plants of five accessions to 15 sites for long-term evaluation, with an additional 41 plants of these accessions provided to 8 public gardens. This year, all accessions were shipped dormant and bare-root.

Web-based planting reports and one- and five-year performance report forms developed by Pete Cyr and Jeff Carstens were used widely by cooperators in 2010 with few problems. These electronic forms drastically reduce the amount of time spent by cooperators and the NCRPIS technician to enter data. Only the ten-year reporting forms remain to be converted to the web-based format.
A brief paragraph with an overview of the NC-7 Regional Ornamental Trials Program has been added to GRIN records for the five accessions distributed in 2010. In addition, links directing Public GRIN users to the NC7 trials webpage have been updated for those accessions and for the vast majority of NPGS accessions tested in the past.

Germplasm activities in crops other than those curated:
Since 2002, Iowa State University and the University of Iowa were awarded two grants from the National Institutes of Health (NIH) to support a Center for Research on Botanical Dietary Supplements, which has made much progress in studying the health-related effects of *Echinacea, Hypericum*, and *Prunella.* Mark Widrlechner continued his involvement with the Center by contributing to the submission of a proposal to renew Center funding (ultimately unsuccessful) and by overseeing a subcontract to ARS (through May 2011), which supports the curation and distribution of the Station's *Echinacea, Hypericum,* and *Prunella* germplasm collections so they can be evaluated for chemical composition, genetic diversity, and bioactivity. Details about his involvement and research publications resulting from these efforts are elaborated in the Medicinal Plant section of this Annual Report.

During 2010, Mark Widrlechner was involved with a number of other collaborative germplasm activities including:

1. service with David Kovach (NCRPIS), Dr. Philip Dixon and Allan Trapp, II (ISU) on a project conducted as part of Allan's M.S. thesis to craft a manuscript for publication that describes the development and validation of a model that predicts maize seed longevity from historical, long-term viability test results;
2. collaboration with Kathy Reitsma on taxonomic verification of *Daucus* germplasm, as part of a larger project involving Drs. Philipp Simon and David Spooner (USDA-ARS, Madison, WI), which should ultimately result in the development of a monograph for the genus;
3. collaboration with Aleš Lebeda (Palacký University, Olomouc, Czech Republic) to prepare an overview of North American explorations for wild *Lactuca*, which was presented to the International Horticulture Congress in Lisbon, Portugal; and
4. collaboration with Peter Bretting (ARS Office of National Programs) and Karen Williams (ARS Plant Exchange Office) in the drafting a Country Report for the United States on plant genetic resources for food and agriculture to be submitted to the FAO.

Research products:
The most promising research product in 2010 may prove to come from our collaborative project on modeling maize seed deterioration, as a new Bayesian statistical approach greatly increased computational efficiency in model development and should simplify the creation of an efficient software package to model the dynamics of seed viability over time for genebank managers.

Mark Widrlechner's other research and training activities:
Collaboration was established with Pauline Drobney (USF&WS, Neal Smith NWR, Prairie City, IA) to assemble information related to the potential invasiveness of Japanese raspberry (*Rubus parvifolius*) for a paper presented at the 22nd North American Prairie Conference, Cedar Falls, IA, in August.

Collaborations continued with Emily Kapler, Jan Thompson, Jeff Iles, and Philip Dixon at ISU to validate existing, and develop new, regional risk-assessment models to predict the likelihood that non-native woody plants will naturalize in the Midwest. Data were recently collected on non-native plant species that naturalized in Iowa but were overlooked in our earlier work to create models and then analyzed with the existing models and a promising new one based on the Random Forest model technique. Data assembly is continuing for non-native species commonly cultivated in the southern half of Minnesota and the northern half of Missouri. Results from our earlier models and a description of our regional plans were made into an interactive presentation, which Mark Widrlechner, Emily Kapler, and Jan Thompson presented to the Iowa Shade Tree Short Course, Ames, IA, in February.

In 2010, Mark Widrlechner continued his service as chair of a national Technical Review Team that provides technical direction and oversight to an ARS project to update the USDA Plant Hardiness Zone Map (PHZM) by using the best available technologies and make the next version of the map accessible via the Internet. As

part of that service, he continued to assist ARS personnel in Beltsville in refining plans for an external contractor to establish a high-volume website to host the PHZM and worked closely with the PRISM group at Oregon State University and other researchers by coauthoring two manuscripts that describe the technical aspects of map development, the results of that effort, and potential horticultural applications. These papers have been accepted for publication in "Journal of Applied Meteorology and Climatology" and "HortTechnology." He serves as ADODR on a Specific Cooperative Agreement with Oregon State for that project.

Results from research to develop a model to predict maize seed longevity are quite promising and may lead to the development of software for gene bank managers. Mark continued his collaborations with Allan Trapp II and Philip Dixon (ISU) and David Kovach to refine this predictive model during 2010. Mark presented results from this project to the 3rd NPGS Curators' Workshop and helped prepare them for a publication that was nearly ready to submit by the end of 2010.

Other Horticultural project-training and staff-development activities:
In 2010, Mark Widrlechner and Jeff Carstens attended the Iowa Shade Tree Short Course.

Manuscript and Proposal Review:
Mark Widrlechner continued his service on the Editorial Review Boards of "Genetic Resources and Crop Evolution," the "Journal of the American Rhododendron Society," and the "Journal of Environmental Horticulture." He served as a peer reviewer for manuscripts submitted to five other scientific journals, and as an internal reviewer for one paper prior to journal submission. He also reviewed NPGS Plant Exploration proposals.

Posters, Presentations and Seminars:
Drobney, Pauline M., and Mark P. Widrlechner. 2010. Japanese raspberry (*Rubus parvifolius* L.): An invasive species threat in savanna and prairie. Presented to the 22nd North American Prairie Conference, Cedar Falls, IA, 4 August. Conference Program, p. 73 (abstract).

Kapler, Emily, Mark Widrlechner, and Jan Thompson. 2010. What's going to invade? Regional risk-assessment models for non-native woody plants. Presented by the entire team to the Iowa Shade Tree Short Course, Ames, IA, 26 February.

Lebeda, A., I. Doležalová, M. Kitner, A. Novotná, P. Šmachová, and M.P. Widrlechner. 2010. North American continent – a new source of wild *Lactuca* spp. germplasm variability for future lettuce breeding. Presented by Lebeda to the International Horticultural Congress, Lisbon, Portugal, 22-27 August.

Trapp II, Allan, Philip Dixon, and Mark Widrlechner. 2010. A decision rule for testing seed viability. Presented to the 3rd NPGS Curators' Workshop, East Point, GA, 2 February.

Widrlechner, Mark P. 2010. Conserving ash trees in eastern North America in the face of potential extinction. Invited presentation to Drake University Biology Seminar, Des Moines, IA, 18 February. Modified version of this talk entitled, "Building a comprehensive collection of ash germplasm," was presented at the ISU Horticulture Departmental Seminar on 1 March, at the Symposium of Ash in North America, Purdue University, West Lafayette, IN on 11 March (abstract published in the Symposium's Agenda and Abstracts, pp. 23-24), and at the 4th Global Botanic Gardens Congress, Dublin, Ireland on 14 June (abstract published in the Congress's Conference Program and Book of Abstracts, pp. 114-115).

Publications (other than those involving the Medicinal Plant Collections) which appeared in print (or online) in 2010:

Kovach, D.A., M.P. Widrlechner, and D.M. Brenner. 2010. Variation in seed dormancy in *Echinochloa* and the development of a standard protocol for germination testing. Seed Science and Technology 38(3): 559-571.

Widrlechner, Mark P. 2010. Building a comprehensive collection of ash germplasm. Proceedings of the 4th Global Botanic Gardens Congress, June 2010, posted at http://www.bgci.org/files/Dublin2010/papers/Widrlechner-Mark-P.pdf (10 pp.)

Departmental Activities:

Mark Widrlechner continued as an active member of the faculty overseeing the Plant Breeding and Genetics major of the Agronomy Department at Iowa State University. He also served on Agronomy Department's Greenhouse & Growth Chamber Committee and the faculty of the Horticulture Department. He continued to serve as a member of the POS Committees for Ph.D. candidates in Natural Resources Ecology & Management (NREM), in Agronomy and in Genetics, and as a member of the POS Committee for an M.S. student in NREM. He became a member of POS Committees for Ph.D. students in Statistics and Horticulture and an M.S. student in Interdisciplinary Graduate Studies.

Conclusions and Plans for 2011:

Curation:

Curation efforts in 2010 focused on *Fraxinus* acquisition and seed processing, with samples from more than 400 mother trees processed by the end of the year. Given the serious threat caused by the continued expansion of Emerald Ash Borer in the North Central Region, we will continue to collaborate with Kevin Conrad (National Arboretum), Ned Garvey (Plant Exchange Office), Dave Ellis (NCGRP), Kris Bachtell (Morton Arboretum), and Bob Karrfalt (USDA Forest Service) to refine and execute plans to conserve North American ash (*Fraxinus*) germplasm (and acquire Chinese germplasm). 2010 was once again not a very good seed production year for ash in much of the central and eastern U.S., but we are hopeful that 2011 will be more productive. We are planning a collection trips to northern Pennsylvania and southern New York in concert with the Arnold Arboretum in 2011, and a potential trip to West Virginia in 2012. We will continue efforts initiated in 2010 to work with David Ellis on integrating ash seed collections from various sources currently held in black-box storage, when the passport and seed-quality data warrant and donors permit.

Also related to the acquisition of tree germplasm, we have established a collaboration with Andy Schmitz at the Brenton Arboretum, Dallas Center, IA to assemble collections of *Gymnocladus* (Kentucky coffeetree). NCRPIS currently holds 35 accessions of *Gymnocladus dioicus* represented as seed collections from native populations. In order to create a more comprehensive collection, additional trips are being planned. Efforts will hopefully facilitate the future selection of superior trees for nursery production and subsequent use in managed landscapes.

Regenerations in 2011 will focus on producing control-pollinated seeds from the large number of shrub accessions now established in field cages and those that should be ready to transplant to field cages, and on unavailable accessions of *Monarda* and *Sanvitalia*. The shrub cages will be featured during the 2011 meeting of the Woody Landscape Plant Crop Germplasm Committee, which will be hosted by the NCRPIS.

A major development that necessitates special curatorial planning is the upcoming reintegration of the medicinal plant collections, currently curated by Luping Qu, back into the Horticulture project. As we end 2010, the medicinal collections are well conserved with few accessions remaining in the field to be regenerated, so we do not expect this process to be very burdensome during the coming year. Luping will remain on staff through spring of 2011 and can assist with this transition.

An evaluation project to assess seed-lipid composition in all available *Calendula* accessions will be conducted by Terry Isbell (NCAUR, Peoria, IL) in 2011, once storage of samples regenerated in 2010 is complete.

A final test of paclobutrozol on *Rhus* is planned for 2011, as part of our broader effort to increase the efficiency of maintaining long-term plantings. A field of side-oats grama should now be ready for burning and use for long-term tree and shrub plantings with reduced input use and more efficient overall maintenance.

An extensive collection of reports on the evaluation of NC7 Trial plants was published from the 1960s until about 1980. These reports are not widely available. During 2002, Kyle Cavanaugh scanned these reports and created PDF files. These reports have been indexed and, in 2011, we plan to link them to accession records in GRIN.

With regard to IT advancements, we look forward to testing new features resulting from the ongoing development of GRIN-Global, and also to the development of a web-based system for the capture and management of all data from the NC-7 Regional Ornamental Trials. The latter will result from GRIN-Global development and implementation.

Ames-numbered, ornamental and mint-family accessions that are currently available for distribution will be considered as candidates for the assignment of PI numbers in 2011, which involves passport-data proofing, identity verification, and duplication checks. Another major passport-data proofing project involves the completion of our ongoing review of georeferencing done by IRRI from historical source and origin records on GRIN. Each set of geographic coordinates and changes

to passport data proposed by IRRI is being checked and, if necessary, corrected before being loaded to GRIN.

Research:
Considerable progress was made on a wide range of research projects during the past year as outlined above.

Research efforts for the coming year (for crops other than medicinal plants) will focus on:

1. assisting Emily Kapler analyze the results of a comprehensive stakeholder survey regarding views on invasive species, risk-assessment modeling, and the concept of "relatedness to nature," complete a manuscript on validation of Iowa risk-assessment models for a new set of non-native species cultivated in Iowa, and perform tests of risk-assessment models based on data on the native ranges and biological characteristics of non-native woody plants cultivated in Minnesota and Missouri, with an overall goal of developing broader, regional risk-assessment models for the Midwest;
2. ensuring the publication of two "accepted" manuscripts describing technical aspects of the development of the USDA Plant Hardiness Zone Map (PHZM) and horticultural applications of the map, along with the PRISM group at Oregon State University and other collaborators, and the completion of an official release of the PHZM via a high-volume website;
3. completing and submitting a study for publication that uses long-term germplasm viability records and distribution histories to estimate target quantities for seed regeneration; and
4. working with Maria Erickson to elaborate her M.S. thesis project to investigate factors that may influence differences in long-term viability among maize accessions, and, with Allan Trapp, David Kovach, Philip Dixon, and Mark Millard, to identify appropriate viability-testing intervals for stored maize samples that balance the resources used to conduct these tests with the need to identify samples that are declining in viability.

Staff Development:
Plans for staff development for 2011 will focus on training experiences for Jeff Carstens, which are likely to include attendance at the Iowa Shade Tree Short Course and safety training.

E. Maize Curation (M. Millard, M. Lively, T. Moore)

Equipment:
The maize curator spends a large portion of his time testing GRIN-Global software in a client-server environment. To assist and speed this process up he was presented with a second Dell Optiplex 755 computer with a Intel Core 2 Quad CPU Q9550 running at 2.83 GHz with 8 gigs of memory with 64-bit Microsoft Server 2008 R2 software installed. This software permits running Hyper-V virtual machines with snapshots allowing rapid switching between running GRIN-Global on Windows XP, Windows 7, Vista, and Microsoft Server 2008 R2. This technology is the only

way GRIN-Global can be tested on these various platforms and still permit the maize curator enough time to attend to maize curation duties.

Personnel:
The maize curation project full-time staff remained stable in 2010 with Trent Moore (ISU Ag Specialist), Matt Lively (Federal Ag Technician), and Mark Millard (Federal Geneticist/Maize Curator) to handle ongoing maize collection maintenance duties. Additional support from Dr. Ed Buckler enabled hiring of a term federal technician, Bruce Hall, in April to assist with the additional work required for DNA sampling and phenotyping the entire available inbred line collection. Federal student labor for maize curation hovers at just under 3.75 full time equivalents with future reductions expected, budget pending.

Research Progress:
All available NCRPIS inbreds were planted for genotyping and phenotyping at four locations. Locations and location leaders were; North Carolina, J. Holland; Missouri, S. Flint-Garcia; New York; E. Buckler; and Iowa, C. Gardner. In all 2,572 entries were assembled in Ames, consisting of 2,200 inbreds from the NCRPIS collection and 222 entries not yet in the collection from other sources. There were a number of inbreds with two or more origins that were planted with the hope that the resulting data would help identify and remove potential redundancy within the Ames collection. Bruce Hall with student assistants sampled leaf tissue at Ames and Missouri and shipped samples to the Buckler lab for DNA extraction and SNP genotyping data acquisition. Plant phenotyping was performed at all four locations in the field with a focus on maturity. Ears were selfed at Missouri for later lab analysis. Open-pollinated ears were harvest in Missouri and brought to Ames for shank, husk, and ear phenotyping. These activities were supported in large part by funds provided by E. Buckler.

Bad weather visited the Ames location throughout the growing season. Cool weather after planting reduced the stand. Heavy rains caused soil washing, ponding, and denitrification in a large section of the nursery. Herbicide weed control also was poor due to the heavy precipitation. On the morning of July 18, a windstorm blew down the majority of the early inbreds; especially those with pollinations. The plan was to have selfed ears on the plants that had been tissue sampled for genotyping (already completed), but the Ames nursery had to be abandoned. With the help of Sherry Flint-Garcia and the Missouri staff, Bruce Hall made trips to Columbia to sample tissue from the Missouri location and assist in plant phenotyping and harvest. Dr. Gardner also made an ear-harvesting trip.

The first phase of the GRIN-Global System project neared completion at the end of December 2010. The project is a collaborative effort of The Global Crop Diversity Trust, Bioversity International, and the USDA-ARS. Its goal is to create the next generation of the GRIN system. A scalable, database neutral system, it will provide tools and web interfaces for the management of genebank collections and germplasm information, and for their users. The project development team is led by IT Specialist Pete Cyr of Ames and commenced in early 2008. The maize curator, who has a long history of working with the current GRIN system, was assigned to serve as an analyst on the development team. He is tasked with working with GRIN users to identify and provide work flows and system needs to the software developers, and to help develop specifications for the new curatorial software tools. Additionally he is heavily involved with initial testing before release to a wider group of testers. Please see the project website at http://www.gringlobal.org/index.php/Main_Page for additional information.

"Release and train" were the GRIN-Global buzzwords in 2010. Major releases, "release candidates" (RC1, RC2) went out for wide public testing in March and September, respectively. Testers, including the maize curator, have an almost weekly chore of testing "interim releases" that progressively address fixes and provide new enhancements with each major release. The maize curator was part of a team of GRIN-Global trainers for three training sessions. On April 12-23 in Beltsville, MD, the first Train-the-Trainer session occurred for 18 international participants. The intent of this workshop was to train those who would help deploy this software to genebanks around the world and gain feedback for system features and functions. On September 27-29, a follow-up session was held in Beltsville with many of the above participants with the intent of demonstrating improvements to the software and ways to migrate data from existing genebank information systems. On November 15-22 a second Train-the-Trainer session was held in Ames, IA for 10 more individuals from countries not represented during previous sessions. At all of these international training sessions, a few current U.S. NPGS GRIN users also attended, laying the groundwork for future U.S. NPGS adoption of the GRIN-Global System. Feedback from workshop participants on system functions and enhancements has been invaluable. On September 30 – October 1, presentations were made by the GRIN-Global developers to the GRIN-Global Technical Steering Group on the progress of the project, and they gave recommendations for moving forward. All of the sessions mentioned above included the maize curator as a presenting team member.

Acquisition:
Statistics show a 178 accession increase in 2010 (Table 1) maize holdings over 2009. These include 46 expired Plant Variety Protected (PVP) accessions and 16 GEM releases. There were 16 inbred lines donated by Dr. John Doebley of the University of Wisconsin. These lines were created by selfing 16 representative racial populations to at least the S6 generation. A SNP assay performed by the donor of these inbred lines indicated 3% heterozygosity, the same as most inbred lines in the same assay. These lines should be a good research compliment to the work done by the GEM Allelic Diversity Project to develop inbred lines from landraces, where doubled-haploid technology is used on plants derived from populations created by crossing elite temperate lines to the landraces to adapt the germplasm enough to be worked at temperate latitudes.

Doebley Race Representative Lines		
Line	**Race Sampled**	**Region Sampled**
MR01 (Araguito) S6	Araguito	Venezuela
MR02 (Assiniboine)	Northern Flint	USA-Great Plains
MR05 (Cateto) S6	Cateto	Argentina
MR07 (Comiteco) S6	Comiteco	Guatemala
MR08 (Costeno) S6	Costeno	Colombia
MR09 (Cravo Riograndense) S6	Cravo Riograndense	Brazil
MR10 (Cristalino Norteno) S6	Cristalino Norteno	Chile
MR11 (Cuban Flint) S6	Cuban Flint	Caribbean
MR12 (Havasupai)	Southwestern 12-Row	USA-Southwest
MR14 (Longfellow Flint)	Northern Flint	USA-Northeast
MR18 (Reventador) S6	Reventador	Mexico
MR19 (Santo Domingo)	Southwestern 12-Row	USA-Southwest
MR20 (Shoe Peg) S7	Southern Dent	USA-Southeast
MR22 (Tuxpeno) S6	Tuxpeno	Mexico
MR23 (Zapalote Chico) S6	Zapalote Chico	Mexico
MR25 (Pororo) S5	Pororo	Bolivia

Dr. Natalia de Leon-Gatti donated 26 Wisconsin public inbred lines. Dr. Dennis West of the University of Tennessee donated a new Tennessee line T179 selected from a GEM release. Finally a large group of 63 teosintes collected by joint CIMMYT-USDA-ARS collection trips was received in 2010. These will be distributed under the SMTA.

Regeneration:
There were 560 (2.8% of the collection) *Zea* accession regeneration attempts in FY 10. This compares with 402 (1.9% of the collection) in FY '09'. Thanks to the very generous increase performed by Monsanto of 250 tropical accessions on Oahu, Hawaii, the regeneration statistics look much better this FY. For perspective, maize accessions store for about 30 years in the intermediate cold storage conditions at Ames. The breakdown of the regeneration nurseries are as follows:

1. A slightly larger Ames nursery consisting of 280 accessions was attempted in the summer of 2010 compared to 252 in 2009 (2,576 vs. 2,237 25-foot rows). Of these accessions, 239 were inbred lines. Sixty-one of these inbred lines were expired PVPs. Only 41 populations were grown to reduce labor requirements.

   The soils were slow to warm up in April, but a dry spell in early May allowed planting of the largest field on May 6. A cool wet spell delayed a second planting until the third week in May. Overplanting of seed gave adequate stands on most increase plots, but the inbred observation plots that were not overplanted had some poor stands. The season improved in June and early July so that early pollinations looked very good. However, there was some telescoping of flowering time caused by early cool weather followed by hotter days. This made it difficult to keep up with pollinations. At peak pollination time on the morning of July 18 a storm with 65-75 mph winds hit. This flattened some accessions and caused severe green snap on others. The next couple of days were spent standing and stomping up most of the nursery. Timely shoot-bagging was difficult. Some accessions were abandoned. Rains continued until mid August. This is the first year where some expired PVP's were not successfully increased. The rest of the season was good corn

growing weather. Killing frost was later than average, so most of the nursery matured except for the very latest lines. Most seed quality was good unless the plants matured lying down. No Stewart's wilt was observed in any increases, as was true in 2009. This means no ELISA testing is necessary on 2010 Ames increase lots to meet international phytosanitary requirements. All factors considered, the 2010 summer maize regeneration year rated as about average for Ames.

2. Monsanto grew, pollinated, harvested and shipped 250 tropical populations on Oahu, Hawaii between February and July 2010. The target was 100+ females per population from 300 kernels planted. The maize accessions planted were from: Australia 2, Columbia 13, Cuba 1, Ecuador 1, Egypt 1, Ethiopia 1, Guatemala 54, Guinea 2, India 1, Mexico 154, Peru 16, USA 3, and Venezuela 1. Seventy races were represented. Most increases look very good and are being processed. Many thanks to all at Monsanto who assisted in this large tropical nursery.

3. Dr. Terry Foley managed the regeneration of 14 expired PVPs at various locations. Thanks for his effort.

4. Eighteen tropical inbreds were planted at ICIA in the GEM winter nursery. Many thanks to Mike Blanco and Andy Smelser.

5. Greenhouse increases included five teosintes and eight tropical inbreds.

6. Fifty landrace populations representative of races adapted to higher altitude were planted in the fall of 2010 by Monsanto on Oahu, Hawaii

7. Thirty-six tropical inbred accessions were increased by ARS staff in St. Croix. These were mainly NAM parents or Goodman-Buckler diversity set inbreds in high demand.

8. Five expired PVPs by GEM team in Puerto Rico that failed in Iowa.

9. Dr. Krakowsky provided increases of 11 late inbreds, including CIMMYT, North Carolina and South Carolina lines.

Maintenance:
Table 1 indicates that maize accession availability was maintained at 66% at the end of 2010. A 1% increase in availability was experienced the previous 3 years. In 2010, 394 *Zea* accessions were made available in 2010, giving a net gain of 143 accessions. In 2009, 377 maize accessions were made available, a net gain of 252 available accessions. This compares with a net gain of 298 in 2008 and 321 in 2007. Reduced gains can be attributed to more new accessions being received and the lower success rate experienced during the 2010 Ames season due to weather conditions. Efforts in recent years have been focused on increasing inbreds and expired PVPs to meet demand. Flat budgets and staffing make substantial increases in the number of available accessions difficult.

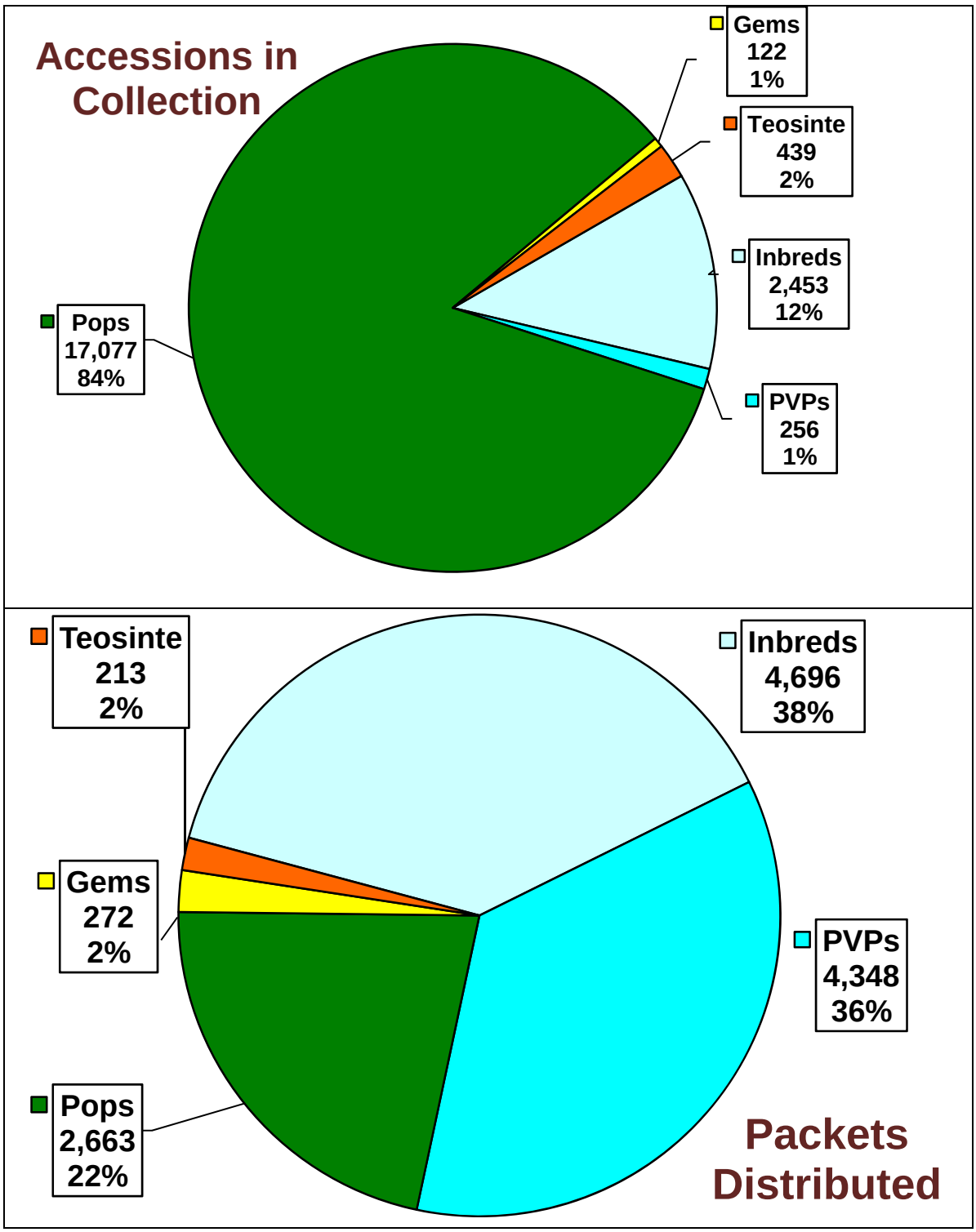
Viability testing in 2010 follows the pattern set in recent years with 982 accessions tested representing 5% of the collection. Six percent, 7%, and 5% of the collection was tested in 2009, 2008, and 2007, respectively. A goal of doing a test every 10 years on collections is desirable to make sure seed is as healthy as possible for research. In 2010, 105 accessions were backed up compared to 71, 368, and 1,027 in the 2009, 2008, and 2007, respectively. The percent backup held at 74% in 2010.

Distribution:

Table 5 shows a leveling off of maize packet distributions (+1.2%) and a reduction in orders (-17%) and the number of requestors (-14%) in 2010. The expired PVP inbred lines continued to be popular distributions, and the reduction in orders may be a reflection of fewer newly expired PVPs becoming available. The pie charts below show the contrast in the number of accessions in each group and the number of packets that were distributed. The workload on the packet filling team was not eased because almost 10,000 packets were prepared for the inbred line phenotyping / genotyping experiment. This experiment is not reflected in the Table 5 data.

Crop	Calendar Year	# of Orders	# of Recipients	# of Items Distributed	# of Accessions Distributed
Zea	2006	585	356	7927	2477
	2007	553	376	8870	2175
	2008	601	406	10424	3457
	2009	768	522	12041	4280
	2010	641	447	12192	3825
Average		**630**	**421**	**10290**	**3242**

Zea Subdivisions	Calendar Year	# of Orders	# of Recipients	# of Items Distributed	# of Accessions Distributed
Populations	2006	195	163	2132	1463
	2007	207	174	1722	1016
	2008	234	191	2338	1547
	2009	319	276	3928	2810
	2010	255	212	2663	1791
Average		**242**	**203**	**2557**	**1725**
GEMs	2006	28	25	334	66
	2007	23	22	381	67
	2008	27	23	329	81
	2009	25	18	324	87
	2010	22	20	272	102
Average		**25**	**22**	**328**	**81**
Teosintes	2006	59	49	303	77
	2007	67	62	272	43
	2008	60	58	201	42
	2009	64	55	313	149
	2010	51	42	213	93
Average		**60**	**53**	**260**	**81**
Inbreds	2006	265	197	2956	760
	2007	259	203	3314	919
	2008	271	210	5216	1634
	2009	311	238	3721	1040
	2010	279	213	4696	1610
Average		**242**	**203**	**2557**	**1725**
PVPs	2006	214	95	2202	111
	2007	188	106	3181	130
	2008	190	107	2340	153
	2009	236	125	3754	194
	2010	227	141	4348	229
Average		**211**	**115**	**3165**	**163**


Accessions in Collection
Gems 122 1%
Teosinte 439 2%
Inbreds 2,453 12%
PVPs 256 1%
Pops 17,077 84%
Teosinte 213 2%
Inbreds 4,696 38%
Gems 272 2%
PVPs 4,348 36%
Pops 2,663 22%
Packets Distributed

Characterization:
There were 8,217 data points loaded into GRIN on 885 accessions in 2010 compared to 10,242 data points loaded into GRIN on 821 accessions in 2009, 15,641 points on 2,026 accessions in 2008, and 13,001 points on 2,436 accessions in 2007.

We imaged 520 accessions in 2010 compared to 599, 1,378, and 829 in 2009, 2008 and 2007, respectively.

As mentioned earlier, over 2,500 inbred accessions were characterized phenotypically in four locations and SNP data were obtained in E. Buckler's lab from samples taken in Ames and Missouri. The phenotypic data will be available on GRIN after publication. The SNP data should be available sometime in 2011. A subset of 870 of these inbreds was provided to E. Buckler's group for topcross onto inbreds PHB47 and PHZ51 in a Puerto Rico winter nursery isolation for yield testing and phenotyping in Ames, Iowa during the 2011 growing season.

Evaluation:
Two disease screening nurseries were sent out again in 2010. Dr. Bill Dolezal, Pioneer Hi-Bred/DuPont, screened 205 accessions for northern leaf blight resistance and diplodia ear rot screening. Infection was good for both diseases. Lodging and rainy weather interfered with obtaining reliable northern leaf blight or ear rot ratings. Dr. Charles Block, USDA-ARS at the NCRPIS, screened 298 accessions for Stewart's wilt resistance.

Communication:
Again in 2010, several tours were given and there were many venues for exchanges of ideas. The GEM project field day continues to generate visits from many maize scientists who are also interested in the maize germplasm collection. The two maize technicians were involved with more of these tours.

Plans for 2011:
The GRIN-Global project will continue to take a considerable part of the maize curator's time. Regeneration remains this curator's first priority because without viable seed, no other research can be done. Expected reduced student labor staffing due to fiscal constraints will make this a challenge. Many of the items on this year's plans are carryover from 2010 items.

<u>Acquisition</u>:
The University of Illinois retired pathologist, Dr. Don White, has a large collection of inbred lines. We plan to review those holdings for important missing accessions and to begin receiving accessions. We also plan to renew efforts to contact Dr. Zeno Wicks, retired maize geneticist from South Dakota, to ensure there are no additional inbred lines or population cycles that are important to add to our maize collection. Dr. James Brewbaker has a collection of tropical inbred lines we will start to incorporate into the collection in 2011.

Forty-one maize PVPs will expire in calendar year 2011 compared to 55 in 2010 and 34 in 2009. Thirty-four are projected to expire in 2012. In 2013 there will be a considerable reduction in expirations because most of the certificates granted in 1995 had a 20-year term instead of the previous 18-year term.

More GEM accessions will be released for distribution by the NCRPIS in 2011. Plans are to acquire all GEM lines post-release and after the waiting period for exclusive GEM cooperator use.

Regeneration:
Current projected funding will not support a maize-curation project, tropical-maize regeneration nursery in 2011, but a proposal for such a nursery will be included in federal planning in case funds become available for the 2011-2012 winter season. If funds are unavailable, efforts will be confined to small increases in the GEM tropical nursery and voluntary increases by the private sector. Monsanto will be increasing tropical accessions on Oahu, Hawaii, but fewer than in 2010. The GEM and Maize Curation groups continue to improve a photoperiod-control system; currently each unit has approximately 100 rows capacity. A second unit will be built in 2011 dedicated almost exclusively to maize curation project. In previous years, the single unit was shared with the GEM project.

Regenerations in Ames will be maintained at 250-300 accessions annually by reducing the regeneration rows per inbred line accession received. St. Croix will be growing 40 accessions of non-quarantine tropical accessions in the fall of 2011 in place of the quarantine increase, because those needing quarantine increase are few. Dr. Ricardo Goenaga, Research Leader at Mayaguez, Puerto Rico, is working with NCRPIS staff to try to broaden the quarantine permit to allow regeneration of maize from any country. Currently and for all of the time frame that the St. Croix facility has been used for quarantine regeneration, maize cannot be grown from these countries: Bangladesh, Bulgaria, China, Egypt, India, Nepal, Pakistan, and Thailand. China, Egypt and Thailand all have germplasm of interest to the NPGS and its stakeholders.

Maintenance:
Ames-numbered accessions will be reviewed and PI numbers assigned; it is estimated that over 1,200 Ames-numbered accessions and 400 currently available NSL-numbered accessions could be assigned permanent PI numbers. This process is a priority for 2011, following the GRIN-Global project work.

Viability tests will be maintained at 2010 levels. A project analyzing past maize germination results to give a targeted date for the next germination test is underway, led by Dr. Mark Widrlechner. This approach should maximize limited viability testing resources.

Evaluation:
Results of a large 600 accession observation nursery evaluating accessions for potential for successful increase on Oahu, Hawaii will be incorporated into GRIN.

Dr. Torbert Rocheford of Purdue University will provide support to the NCRPIS in 2011 to grow a nursery of ca. 2,500 inbreds and phenotype the lines for tassel characteristics. Most of the accessions will be repeats from the 2010 phenotyping nursery replicated at Raleigh, NC; Columbia, MO; and Ithaca, NY. There will be additions of inbreds regenerated in 2010 and substitutions for accessions that have become unavailable. A federal, term maize technician will continue to do the majority of the work.

The maize curator will attempt to augment the collection of 5,000 images currently on GRIN with images of additional accessions in 2011. These images have already been captured, and will be loaded with the new GRIN loader software developed by NCRPIS staff.

The maize curator will continue to work with the NCRPIS pathologist and interested private and public pathologists to systematically obtain data on maize pathogen resistance in the collection. Additional evaluation information will result in more effective future use of accessions.

F. Medicinal Plants (M. Widrlechner and L. Qu)

Medicinal germplasm curation has been partially supported from an NIH grant awarded to Iowa Center for Research on Botanical Dietary Supplements (Botanical Center), ISU. In May 2010, we were informed by the NIH that the Center's 5-year renewal proposal was unsuccessful. The existing NIH grant ended in the summer of 2010, with additional work being supported through 2010 by carry-over funds and internal (ARS) support.

Acquisition:
During 2010, we received and/or collected 5 new accessions of medicinal species, which represents 1% of the current collection (Table 1). The collection currently consists of 494 accessions.

Availability and Backup:
Sixty-four percent of the NC7 medicinal accessions are currently available (Table 1). In 2010, 30 seedlots of these accessions were made available and 23 accessions were backed up, with 338 accessions now backed up in Fort Collins, representing 68% of the total collection (Table 2).

Regeneration and Maintenance:
In addition to the completion of caged plantings established in previous years, two new fields with accessions of *Hypericum*, *Prunella*, and *Actaea* were established in 2010 for regeneration. Seeds from 53 accessions (16 *Echinacea,* 30 *Hypericum,* and 7 *Prunella*) regenerated in field cages were harvested and processed for storage in 2010.

Viability Testing and Seed Germination Investigation:
Seedlots of 37 accessions were tested for germination in 2010 (Table 2). The testing included recently acquired original samples and those recently regenerated. Testing seedlots of *Prunella* to optimize germination protocols was continued in 2010 with more accessions.

Distribution:
In 2010, 165 items were distributed; of these, 92% were domestic and 8% were foreign distributions (Table 3A). Along with seed distribution, fresh materials of *Echinacea*, *Hypericum*, and *Prunella* from caged-regeneration plots were sampled by Dr. Ludmila Rizshsky at ISU for metabolomic analyses. In the fall, *Echinacea* roots (8.67 kg dry wt) and *Hypericum* (1.58 kg dry wt) and *Prunella* plants (1.35 kg dry

wt) were harvested, dried and ground by a Wiley mill and made available to projects associated with the NIH-funded Iowa Center for Research on Botanical Dietary Supplements (Botanical Center) grant project.

Characterization and Taxonomy:
Accessions of 40 *P. vulgaris* and 25 *H. perforatum* were germinated and transplanted into the field for the purpose of characterization. Nine accessions of *P. vulgaris* were also planted into field for evaluation of biomass (focusing on inflorescence) yield. These plantings were retained to overwinter in the field for 2011.

All the medicinal plants in the cage fields were checked to verify identifications. Misidentification of two accessions of *H. punctatum* was found by Dr. Widrlechner and re-identified as *H. maculatum* and *H. pseudomaculatum*, respectively.

Digital images of plants were taken from 45 accessions of *Echinacea*, *Hypericum*, and *Prunella.* Five images of seeds taken by Lisa Pfiffner were loaded to GRIN in 2010 (Table 4).

Pathogen Observations:
Field plantings were monitored weekly during the growing season for *Colletotrichum gloeosporioides* (anthracnose) and aster yellows disease symptoms. Both pathogens were observed in 2010 on plantings from current and previous years. In the past, infection by *C. gloeosporioides* on *H. perforatum* usually had been found on second- or third-year plants in the field. However, we experienced severe, unfavorable weather conditions in Ames, IA during the 2010 growth season, with much precipitation that led to atypically saturated soils, high humidity, and less sunlight, and most importantly to more disease infection, even on first-year plants. A *C. gloeosporioides* seed-screening protocol for *Hypericum* accessions continues to be utilized for all newly received and freshly harvested seed accessions. All germination and pathogen data collected have been entered in the GRIN database.

Analysis of Breeding Systems, Ploidy, and the Role of Hexaploids in Three *Hypericum perforatum* Populations:
This research project was completed in 2010. The results were published in "Industrial Crops and Products."

***Prunella* Breeding System Investigation:**
Additional investigation was conducted on this project in 2010. Seed production was evaluated in bagged and un-bagged flowers in isolation cages with honeybees to facilitate pollen distribution. This research project was completed in 2010. A manuscript developed from this research was recently accepted for publication in "HortScience."

Vernalization of Young *Prunella* Seedlings for Promoting Reproductive Development:
Without over overwintering, newly established *P. vulgaris* seedlings typically do not flower in field. However, we have found that some accessions of *P. vulgaris* flowered in the first growing season after young seedlings were stored at ~4 ^{o}C for 27 days before they were transplanted. With this finding, we have designed and conducted

an experiment to determine the developmental stages that are most sensitive to cold treatment, and the most effective temperatures and duration needed for the cold treatment. One accession was used in this study. Early results indicate that seedlings at the 1 to 2 true leaf stage can flower about two months after removal from 4 °C, at which seedlings were held for as little as 14 days, but no stimulatory effects were observed for seedlings when treated at the cotyledon stage. This research is ongoing. Results from this investigation may be useful in gene bank seed regeneration and also in field production of *Prunella* inflorescences which are the main commercial product for medicinal use.

Reducing Seed Dormancy in *Echinacea* by Selection and Breeding:
This project started in 2009. Wild populations of *Echinacea* have strong seed dormancy. Development of methods that can effectively break *Echinacea* seed dormancy has been a key focus in *Echinacea* field-production research. Since it has been documented that light promotes *Echinacea* seed germination, we reasoned that the earlier a seed germinates in dark, the less it has dormancy. On the other hand, a seed that germinates late in light is likely to have stronger dormancy. Two accessions of *E. angustifolia* and three of *E. pallida* with strong dormancy were used in this investigation. Plants grown from the early, in-dark germinated seeds were planted in the field for producing next generation seed for evaluating reduced dormancy and seeds from plants generated from late, in-light germinated seed were used as a control.

We harvested seeds from the *E. pallida* plants in 2010, but did not obtain seeds from the *E. angustifolia* plants due to unfavorable weather as mentioned earlier. Seed germination results indicate that our selection method, even after a single cycle, can be very effective in reducing seed dormancy in *E. pallida* (Table below), and the selected seedlot germinated substantially faster than did the control (Figure 1).

Germination (%) comparison among seed lots of 3 *E. pallida* accessions

Treatment	Accession	n	Seed Lot	
			2010 in-D[z]	2010 in-L[y]
Lt, 25 °C	PI631276	300	93 ***	50
	PI631322	300	84 ***	42
	PI649036	300	46 **	29
Dk, 25 °C	PI631276	300	25 **	0.3
	PI631322	300	36 ***	4
	PI649036	300	4	2
Lt, 20/30 °C	PI631276	99	73 ***	23
	PI631322	99	54 **	14

[z]Seeds from in-dark selected plants harvested in 2010.
[y]Seeds from in-light selected plants harvested in 2010.
,* t- test for within row mean separation, $P < 0.01$, $P<0.001$, respectively.

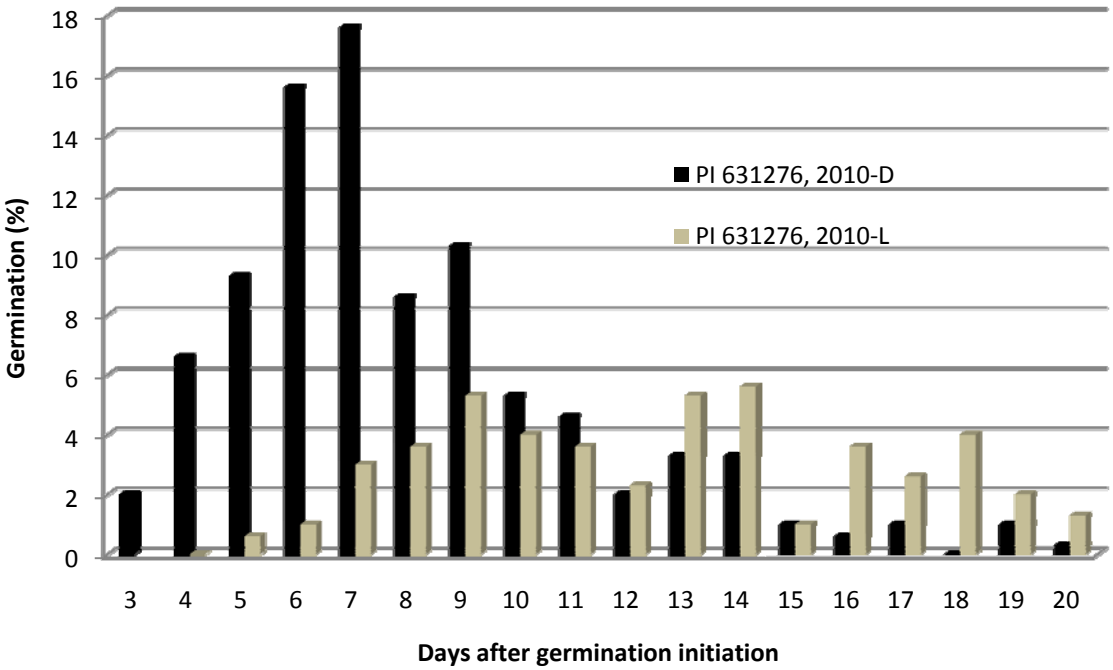


Figure 1. Daily germination variation of 2010 seed lots of *Echinacea pallida* accession PI 631276 under 25° C with light.

Medicinal Plant Publications by Mark Widrlechner and Luping Qu for 2010:

Qu, L., M.P. Widrlechner and S. Rigby. 2010. Analysis of breeding systems, ploidy, and the role of hexaploids in three *Hypericum perforatum* L. populations. Ind. Crops Prod. 32: 1-6.

Plans for 2011:

Regeneration:

There will be no new plantings in 2011. The 2010 plantings of *Prunella* and *Actaea* accessions will be monitored after re-growth starts and for seed production.

Characterization and Evaluation:

The 2010 plantings of *Prunella* and *Hypericum* will be evaluated in 2011 growth season.

Image loading:

Digital images taken in 2010 growth season will be loaded in GRIN.

Transition:

The separate medicinal curator position will be eliminated in 2011 due to the completion of the NIH grant. An orderly transition of the current curation activity will be done in concert with the Horticulture project.

G. Oilseed Crops (L. Marek, L. Crim, I. Larsen)

Project management:
Farm worker, L. Crim continues to work on the oilseeds project half-time.

Acquisitions:
We received 115 new oil seed accessions in 2010.

Helianthus:
One cultivated *Helianthus annuus* accession with expired property rights protection (PVP) was received from NCGRP, Ft Collins. This accession was increased in the greenhouse winter 2010/2011. Forty-seven cultivated accessions were requested from NCGRP, the majority of which had been at Ft Collins prior to 1991 but never forwarded to Ames. Twenty five of the accessions were made available as original seed. Twenty-two of the accessions were successfully increased in the field. During a 13-day NPGS Plant Exchange Office (PEO) funded plant exploration to Louisiana, Mississippi, Alabama and Florida, Dr. Marek and USDA sunflower botanist Dr. Gerald Seiler, Fargo, ND collected 55 accessions of *Helianthus* from wild populations [*H. agrestis* (6), *H. angustifolius* (7), *H. floridanus* (2), *H. heterophyllus* (13), *H. radula* (21), *H. resinosus* (1), *H. silphioides* (4), and *H.simulans* (1)]. Eighty percent of the new wild accessions should be available as original seed when accessioning is complete. The collections of *H. silphioides* (2) from the "pimple mound" region in southwestern LA represent a significant addition to the genetic diversity of this taxon in the NPGS. The *H. heterophyllus* collections represent a southern complement to the 2008 collections in this species' northern range (NC and SC) and serve to replace non-viable material collected in the late 1970s and early 1980s. One *H. mollis* accession was received from a PEO-sponsored collection trip to Kansas.

Brassicaceae:
Two accessions of *Brassica napus* with expired plant variety protection (PVP) intellectual property rights were received from NCGRP, Ft. Collins. Both accessions are winter type canolas, and both are available for distribution as original seed. In addition, one Brassicaceae accession was transferred from the Western Regional Plant Introduction Station, material wild collected in Alaska in a cooperative project with the BLM.

Miscellaneous asters:
One accession was transferred from the Western Regional Plant Introduction Station, material wild collected in a cooperative project with the BLM, and one accession was received from a PEO-sponsored collection trip to Arizona.

Collection Maintenance:
General statistics about availability and management of the collections are presented in Tables 1 and 2 in the appendix. Fewer regenerations than the long term average continue to be handled due to the availability of less support staff. Selected details for oilseed accessions increased during 2010 are noted below.

Helianthus, Ames increases:
Cultivated *H. annuus* accessions are 93% available. We are managing our increases to maintain a high level of availability and to ensure that the core collection

accessions are available for distribution. In 2010, 55 *H. annuus* cultivated accessions were regenerated. Wild annual *Helianthus* accessions are 95% available, and wild perennial accessions are 62% available (steady annual improvement since 2004 when the wild perennials were 20% available.). We caged 62 wild perennial *Helianthus* accessions and harvested seed from 56. The primary wild perennial fields suffered significant damage to cages and screens during a mid-July line-force wind storm. About 90% of the cages were damaged and six could not be re-constructed.

Helianthus, Parlier alternate grow-out site:
We continue to work with NPGS Parlier, CA personnel to increase wild taxa which require a longer growing season than is reliably obtained in Ames. The Parlier environment also provides a valuable alternative for growing mountain and desert species which do not survive in the mid-western humidity and heavy soils. The Parlier location has 40 sunflower cages, purchased by NCRPIS, and can grow up to 40 sunflower accessions per year. In 2005 we implemented the increase protocol of germinating seed in Ames and shipping live seedlings to Parlier. The Parlier staff transplant seedlings and manage plant growth. Accessions are caged before flowering and introduction of pollinator insects (purchased by NCRPIS); harvested material is shipped to Ames for threshing and processing. In 2010 we sent seedlings for 29 accessions, all of which were established in the field and harvested. In addition, one accession established in 2009 was re-caged and harvested in 2010. The 2010 harvested material arrived in Ames in November and December and is being processed.

The Parlier group records basic field data (date transplanted, dates of harvest) but does not have the staff to record standard descriptor data, such as ray and disc flower color, plant height, and branching characteristics nor to take images. Because some accessions represent taxa which we never see growing in Ames, it is important that the observation data be captured. In September 2010, Mr. Larsen, oilseeds project technician, and I traveled to Parlier to record descriptor information and to take images.

Brassicaceae:
Brassicaceae accessions are 89% available. We continue to work towards having at least 90% of this division of the oilseed collection available. In 2010, field populations for 40 Brassicaceae accessions, 29 *Brassica* and 11 miscellaneous crucifers, were established. Seed was harvested from 38 of the field-established accessions. Two of the *Brassicas* were accessions that had failed in 2009 due to severe black rot infection. Seed was treated (standard hot water treatment) before planting in 2010 and field increases were successful. Three accessions, two *Brassica* and one *Lepidium*, did not flower and were transferred to the greenhouse at the end of the season. In addition to the fall transferred material, five *Matthiola incana* accessions were started in September for winter 2011 flowering and harvest. Many wild Brassicaceae in the collection are of Mediterranean origin and could be expected to flower during cool, moist, short-day weather. We have had good success increasing *Erysimum* accessions by starting plants in early fall and maintaining them in the cool winter greenhouse for winter/early spring harvest. We have begun using this strategy with other genera, such as *Matthiola* that flower too early to be successful in the field in Ames. The 2010 fall-started accessions are in full flower.

Fifteen greenhouse-maintained Brassicaceae accessions were harvested in 2010 (four *Brassica* and 11 miscellaneous crucifers), six of which had been transferred from the field in fall 2009.

Linum:
Cultivated flax accessions are 99% available. One accession of *Linum usitatissimum* was planted and harvested in 2010. Wild flax accessions are 76% available. Two wild flax accessions were harvested in 2010, both from greenhouse-maintained populations.

Cuphea:
Seeds are available for 95% of the accessions of seven species (*Cuphea calophylla, C. carthegenensis, C. lanceolata, C. lutea, C. tolucana, C. viscosissima, C. wrightii)* and the *Cuphea* hybrid accessions that have been part of the PSR23 breeding efforts by members of the National *Cuphea* Consortium for the agronomic development of *Cuphea* as a domestic source of mid-chain fatty acids. Over all, the *Cuphea* collection is 80% available. Four accessions were established in the field in 2010, and all four accessions were harvested. In addition, seed was harvested from one of the accessions caged for experimental work (see Research Activities) by Dr. Marna Nelson, ISU.

Miscellaneous asters:
Overall, the miscellaneous asters are 24% available. There were no increases of miscellaneous aster accessions in 2010.

Euphorbia:
The *Euphorbia* collection is 42% available. In response to potential future interest in *Euphorbia lagascae* as a non-petroleum source of vernolic acid for the "green" building trade, in 2008 we began to increase the availability these accessions, the first field increases of *Euphorbia* at the NCRPIS since 1998. In 2010, increases for 12 *E. lagascae* accessions were attempted, one of which had no surviving seedlings for field transplant. Seeds were harvested from nine of the 11 surviving accessions; the excessively wet 2010 summer season had a negative impact on the success of *E. lagascae* regenerations. This species is now 58% available, an increase in availability of 2% over 2009.

Distributions:
General statistics about oilseed collection distributions are presented in Table 3 in the appendix.

Helianthus:
In 2010, the largest proportion of orders and the most accessions were distributed to support disease- or pest-related research; however, requests for material to support genetic- or genomic-related research continue to be strong. A large number of accessions were also distributed to support breeding programs in oil, confectionary and ornamental germplasm with interests in agronomic characteristics, such as salt and drought tolerance, branching characteristics, dwarfing, oil and tocopherol content and adaptation to non-"standard" sunflower environments (subtropical lowlands). We also provided germplasm to support the Agronomy Department's display at Iowa State University's annual spring celebration,VEISHEA.

Brassicaceae:
Diversity in the Brassicaceae collection (262 taxa from 21 genera) supports a wide range of research purposes. The largest single order was a request for 1580 accessions of four *Brassica* species and *Camelina* to support biofumigant research. The use category "disease-resistance research" or the equivalent commanded the next largest number of accessions; however, there were more total orders requesting material to support genomics- or molecular-based research or the equivalent. Selections of the Brassicaceae collection continue to be distributed to support phytoremediation research and for oil composition, biofuel and oil-crop evaluation.

Linum:
2010 requests for flax germplasm generally supported breeding efforts including an evaluation in southeastern Australia. One flax request included available wild species for use in a taxonomic study.

Cuphea:
The majority of *Cuphea* requests in 2010 were for material to support ornamental breeding efforts. In addition accessions were requested for metabolic flux analyses.

Euphorbia:
Euphorbia accessions were distributed during 2010 to support production-biology efforts and ornamental-breeding work. Six orders shipped in one year continues the trend begun in 2008 of an increase in *Euphorbia* requests, compared with an average of two orders per year from 2003 - 2007.

Miscellaneous asters:
Accessions from the NCRPIS miscellaneous asters collection were sent to support ornamental breeding, to use to test chemicals intended to control invasive weeds and to investigate phytochemical composition and its contribution to herbivore resistance.

Research Activities:
General statistics about observations and images recorded for the collections are presented in Table 4 in the appendix.

Helianthus:
Woody Biomass Trait Analysis: We continued field work in support of a multi-year, multi-location $1.2 million research project evaluating woody traits in sunflower funded by the USDA/DOE (Ames is funded directly by the DOE). Overall grant management, a second field location, and all breeding and genetic/genomic work are taking place at the University of Georgia, Athens, GA. Chemical analyses are being handled by the National Renewable Energy Laboratory (NREL) in Golden, CO. The University of British Columbia, Vancouver is providing an additional field location. In February 2010, Dr. Steve Knapp, grant leader at that time, two UGA post docs and myself met at NREL to define remaining project goals and field plans.

In addition to providing germplasm in support of the genetics and genomics portions of the project, in 2010 we grew 320 single-plant field plots (*Helianthus argophyllus* for association mapping) and 960 single-row field plots [384 *H. annuus* recombinant inbred lines (RILs) developed from a cross between an elite oilseed inbred and North

American landrace and 288 *H. annuus* inbreds, selected landraces and historically important open-pollinated cultivars for an association mapping study]. Plants from 278 of the RILs were phenotyped. The *H. annuus* association-mapping population was planted in duplicate; plants from all 576 plots were phenotyped. Phenotypic observations recorded included flowering date, anthocyanin content in disc florets and stigmas, plant height, number of branches, stem diameter and density, and flower-head diameter. Heads were bagged in the RIL populations and the *H. annuus* association mapping study and the RIL material manipulated to allow an estimate of self-autonomous pollination in individual lines. Heads and dried stem sections were sent to UGA for further processing and preparation for NREL from the RIL and *H. argophyllus* mapping population studies. Stem-section samples from the *H. annuus* mapping population study are being prepared and will be shipped to NREL directly from Ames. Some seed characteristics were determined in Ames; oil composition analyses were handled at UGA. One of the postdocs from UGA spent a week in Ames in September to help with phenotyping during a very busy time for field work.

Disease resistance evaluations: Sclerotinia is the most important disease in sunflower production fields in northern North America. Since 2008, we have been cooperating with Dr. Charles Block, NCRPIS pathologist, and Dr. Thomas Gulya, pathologist, USDA Sunflower Research Unit, Fargo, ND to select and supply germplasm for greenhouse (Dr. Block) and field (Drs. Block and Gulya) evaluations. An initial goal was to screen all untested, cultivated accessions in the field. Field evaluations are labor intensive and clearly subject to variable weather conditions. A second goal has been to develop a greenhouse screen that successfully predicts field response so that only the most promising accessions would require field testing. Dr. Block has been evaluating wild sunflower accessions in the NCRPIS greenhouse from late fall through late spring to identify potentially valuable germplasm for incorporation into cultivated breeding lines. In 2010, 210 wild accessions were screened including annual and perennial species. All tested perennial species showed remarkable resistance, one of which, *H. salicifolius*, is diploid like the cultivated sunflower, potentially simplifying transfer of resistance mechanisms to cultivated breeding lines. *Helianthus salicifolius* was made available in distributable quantities for the first time after the 2009 collection trip for wild germplasm in the South Central United States briefly described in our 2009 annual report. Field tests to confirm greenhouse results of screened wild accessions were not successful due to very unfavorable weather conditions in 2010. Please see the Plant Pathology section of this annual report for more details.

Brassicaceae:
Thlaspi and *Camelina* agronomic characteristics: *Thlaspi arvense* and *Camelina sativa*, Brassicaceae weed species commonly associated with agricultural production world-wide, have remarkable cold tolerance and interesting seed-oil characteristics. Both species complete their life cycles by late spring or early summer suggesting use as a non-food, non-feed biodiesel component in a double cropping system. Ivan Ayala, a Fulbright-sponsored ISU graduate student, has continued work started in 2008 to characterize *T. arvense* and *C. sativa*. During 2010, it was determined that planting depth is a critical determining factor in successful establishment of *Thlaspi* field stands. *Camelina sativa* was less sensitive. Mr. Ayala determined yield and oil characteristics of *C. sativa* seed harvested from field plots. In our on-going

partnership with the New Crops Research Unit, USDA-ARS in Peoria, IL, oil analyses was completed in laboratories there. The project will continue in 2011.

Cuphea:
Gene isolation for fatty-acid biosynthetic enzymes: We have been cooperating with Dr. Marna Yadeau-Nelson, scientist in Dr. Basil Nikolau's lab, ISU, to provide germplasm, field cage and greenhouse space for *Cuphea* plants harvested for RNA and gene isolation. Drs. Yandeau-Nelson and Nikolau are interested in enzymes involved in controlling preferential accumulation in seeds of specific mid-chain fatty acids and a number cuphea species have unique seed fatty acid profiles. We have been able to provide germplasm not available from any other source (notably *C. avigeria* var. *pulcherrima*, *C. painteri*, *C. inflata*, several others). The ISU group has successfully isolated genes for several biosynthetic enzymes.

Collection trips:
Laura Marek was the PI for one targeted collection trip funded by the NPGS Plant Exchange Office (PEO) for wild *Helianthus* germplasm in 2010. In November, Dr. Gerald Seiler, Botanist, USDA Sunflower Research Group, Fargo met Laura in Alexandria, LA. They spent 11 days collecting populations of eight species of wild sunflowers in the southern U.S., traveling 3,555 miles across Louisiana, Mississippi, Alabama and Florida. Two collections of *H. silphioides* in the "pimple mound" region in southwestern LA represent a significant addition to the genetic diversity of this taxon in the NPGS. The *H. heterophyllus* collections represent a southern complement to the 2008 collections in this species northern range (NC and SC) and serve to replace non-viable material collected in the late 1970s and early 1980s.

Professional Activities:
Meetings and Presentations:
In January, Laura attended the 18th Annual Plant and Animal Genome Conference, San Diego, CA and participated in a pre-meeting full day DOE KBase Workshop, a component of participation in the Biomass Feedstocks grant program.

In early February, Laura attended the 3rd Biennial Curator workshop in Atlanta, GA.

In late February, Laura attended a meeting of the Sunflower Woody Biomass group in Golden, CO held at the National Renewable Energy Laboratory facility where project samples are being analyzed for chemical and physical properties.

In September, Laura attended the 22nd Annual Association for the Advancement of Industrial Crops meeting in Ft Collins, CO and presented a germplasm update to the New Crops CGC.

In November, Laura attended the Annual Meeting of the ASA/CSSA/SSSA societies and the National Canola Association Meeting in Long Beach, CA. Laura co-organized the Oilseeds Crucifer Plant Germplasm Committee meeting and presented a germplasm update. Ph.D. student Ivan Ayala presented a poster (Variations in Fatty Acid Composition and Oil Content in *Camelina* Germplasm, Ivan Ayala-Diaz et al.) in the C08 Plant Genetic Resources Division. The Sunflower Woody Biomass group presented a poster (Genomic Analysis of Wood Production in

Sunflower, Sukhpreet Sandhu et al.) in the C07 Genomics, Molecular Genetics and Biotechnology Division.

Publications:
Kim, K., R.W. Gesch, S.C. Cermak, W.B. Phippen, M.T. Berti, B.L. Johnson, and L. Marek. 2010. *Cuphea* growth, yield, and oil characteristics as influence by climate and soil environments across the Upper Midwest USA. Industrial Crops and Products 33:99-107.

Gulya, Jr., T.J., Marek, L.F., and Gavrilova, V. 2010 Disease resistance in cultivated sunflower derived from public germplasm collections**.** Plenary talk/Proceedings of the International Symposium "Sunflower Breeding on Resistance to Diseases", Krasnodar, Russia, June 23-24, 2010, sponsored by the All-Russia Research Institute of Oil Crops (VNIIMK) and the International Sunflower Association.

Grant support:
USDA/DOE Biomass Feedstock grant continuation funding approved: Genomics of Wood Formation and Cellulosic Biomass Traits in Sunflower; Dr. John Burke, UGA, principal investigator, $1,200,000 total funding, of which ISU received $150,000 as a separate DOE contract over three years (FY 2008 - 2011).

FY 2010 Plant Germplasm Evaluation proposal approved and funded, "Evaluation of *Thlaspi* and *Camelina* Accessions", $15,000 (molecular analyses).

FY 2010 Southern US wild *Helianthus* collection trip funded: $7,558.

Genome Canada Genomics of Sunflower, $11 million total funding, collaborator.

Service Activities:
AAIC:
Laura completed a term as head of the Oilseeds Division. Part of the 2009 duties of the Oilseeds Division head involved serving as guest editor for Oilseeds Division papers in a special edition of Industrial Crops and Products comprised of papers submitted from the AAIC annual meeting in Chile, fall 2009, which required a significant amount of time.

NCRPIS:
Laura serves on the NCRPIS Safety and IT Committees.

Agronomy Department activities:
During spring 2009, Laura coordinated the monthly Agronomy Department Professional and Scientific staff meetings. The group did not schedule any meetings in the fall.

Plant Germplasm Operations Committee (PGOC):
Laura serves as a member of the *In situ* Conservation Subcommittee, the GIS and Geo-referencing Subcommittee and the Molecular Subcommittee.

H. Vegetables (K. Reitsma, L. Clark)

Collections curated by the Vegetable Project include *Cichorium* (NC7-chicory), *Cucumis sativus* (NC7-cucumis.cucs), *Cucumis melo* (NC7-cucumis.melo), *Cucumis* species (NC7-cucumis.wilds), *Cucurbita pepo* (NC7-cucurbita), *Daucus* (NC7-daucus), *Ocimum* (NC7-ocimum), and *Pastinaca* (NC7-parsnips). Statistics for accession numbers and availability for each site crop are found in the appendices in "Table 1: NCRPIS Accessions (Accs), Acquired, Available."

Acquisition:
In 2010, 45 new accessions of *Daucus* were collected in Arizona, California, New Mexico, Oregon, and Washington by Drs. David Spooner and Philipp Simon, USDA-ARS, University of Wisconsin, Madison, WI. The collection included 26 *D. carota* and 19 *D. pusillus* accessions.

Maintenance:
Data for vegetable crop regenerations attempted and number of accessions harvested in 2010 are summarized in the appendices in "Table 2: NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up."

Cucumis increases included both greenhouse and field regeneration. Nine *Cucumis metulifer* were planted in the greenhouse in June. Six accessions produced sufficient seed quantities for backup and distribution, while three will need to be regenerated again. Field regenerations included 62 *C. melo*, 31 *C. sativus*, and 18 wild species. Of the 111 accessions planted for regeneration, 81 accessions were deemed successful, 18 had insufficient seed quantities, six failed to produce mature fruit (longer growing season needed), and six failed to germinate. Forty of the 62 *C. melo* failed to produce enough seed in 2009 to allow the accession to be backed up at NCGRP and also be available for distribution, so were grown again in 2010. These 2009 increase lots will be bulked with the 2010 increase lots during the inventory and storage process. Because of low fruit numbers, plants were dug or cuttings were taken from nine of the wild *Cucumis* species field cages and transplanted into pots in greenhouse cages for continued regeneration. Five of the nine were successfully regenerated, two produced insufficient seed, and two accessions had no harvests. One of the two accessions that failed to produce fruit was PI 282446, *Cucumis heptadactylus*, which has been growing since the spring of 2005. This perennial species from southern Africa is dioecious with extremely dissected narrow leaf lobes. Additional seeds were started in 2006 to try to increase the population of female plants, and the plants were dug and/or cuttings taken from caged field plants each summer for continued maintenance in the greenhouse each winter because so few fruit were produced each season. The plants died due to flooding in the field in the summer of 2010. Over the past six years, 183 fruit have produced just over 5,000 seeds. Seeds from each harvest were bulked in 2010, and the accession is now backed-up and available for distribution.

Cucumis heptadactylus vines (PI 282446) in field cage.

Male flowers and leaves of *Cucumis heptadactylus* (PI 282446).

Fruit of *Cucumis heptadactylus* (PI 282446)

Cucurbita pepo field regenerations focused on accessions with low seed quantities or distribution lots 20+ years old. Ten of 15 accessions were successfully regenerated. The five unsuccessful regenerations included four accessions that failed to germinate and one produced no fruit before frost. Ten accessions should be available for distribution after viability testing in April 2010.

Daucus regeneration efforts focused primarily on newer accessions and included germplasm from Greece, Portugal, and Tunisia. Thirty-one accessions were sown in pots in the greenhouse in the fall of 2009. Two accessions failed to germinate, one bolted in the greenhouse but failed to produce seed, and the remaining 28 accessions were vernalized, transplanted into field cages in the spring, and harvested in the fall of 2010. Fifteen *Daucus* accessions from the 2009 Tunisia collection trip were sown in the greenhouse in the spring and transplanted into the 2010 field cages as annuals. Seeds were harvested from 14 accessions. Only half of the plants bolted and flowered on the fifteenth accession, but the flowers did not set seed. The plants that failed to bolt were dug from the field and transplanted into the greenhouse with the hope of getting seeds from the remaining plants. Seed processing continues on the 2010 harvests, and will hopefully be completed by this summer.

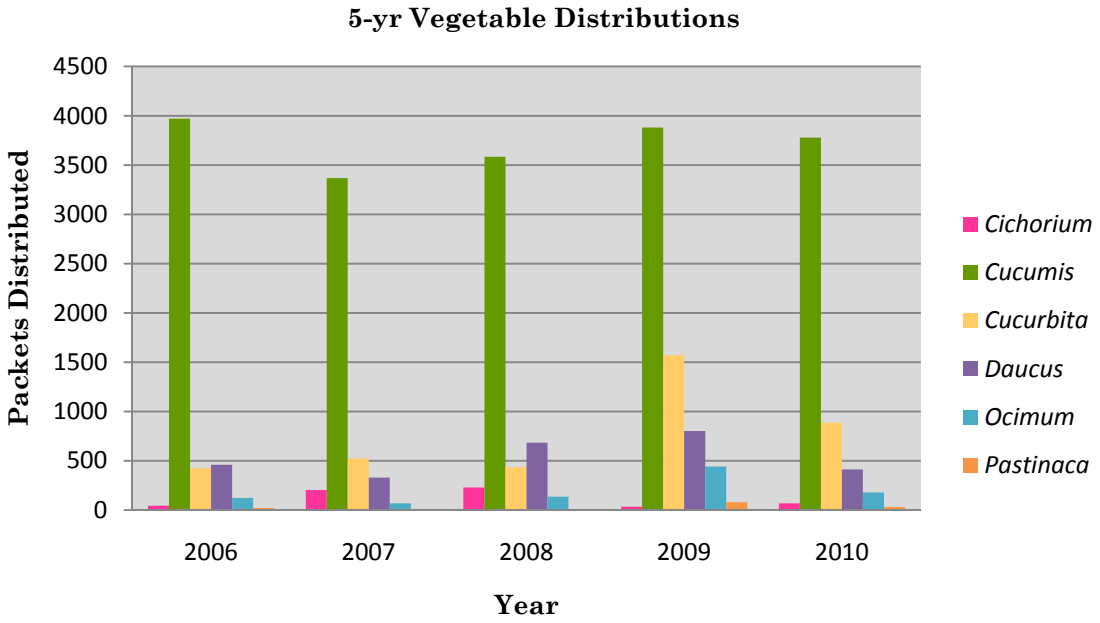
In addition to the *Daucus* regenerations in Ames, we received seed increases from Rob Maxwell, Seminis Vegetable Seeds, Idaho (five accessions), and Roger Freeman, Nunhems, Oregon (four accessions). Another six accessions were sent to Seminis Vegetable Seeds and ten to Nunhems for regeneration in the 2010-2011 growing season. Dr. Maxwell has since left Seminis for a position with Bejo Seed in Idaho, and he hopes to be able to continue to assist with regenerating *Daucus* accessions.

As NCRPIS accessions are regenerated, seed samples are sent to NCGRP for back-up. Overall, 82% of the vegetable collections are backed up, which is above the station's average of 79%. Six of eight vegetable site-crops have 79% or more of their accessions backed up at NCGRP (Table 2). In addition to the backup samples sent to NCGRP, 885 accessions were sent to the Svalbard Global Seed Vault in Norway for backup in 2010 including 661 *Cucumis*, 191 *Cucurbita*, and 33 *Pastinaca*.

No vegetable accessions were inactivated, and no PI numbers were assigned to Ames-numbered accessions in 2010.

In 2010, 845 germination tests (Table 2) were performed including 653 tests to monitor viability of *Cucumis melo* distribution seed lots, 135 tests on regeneration lots, and 57 tests on original seed lots of *Daucus* collected in Tunisia. Subsamples of the *Daucus* original seed lots having sufficient seed quantities with good viability will be sent for backup at NCGRP in 2011.

Distribution:
Packet and accession distributions for the vegetable collections are summarized in the appendices in "Table 3A: External NCRPIS Distributions" and "Table 3B: Internal NCRPIS Distributions." In 2010, 5,356 seed packets (items) involving 3,139 accessions were distributed to fulfill 193 domestic and 85 foreign orders. A five-year distribution history of the vegetable crops is shown in the following chart and in "Table 5: Five-Year Summary of NCRPIS Accession Orders by Crop" in the appendices.



Several requests were received for evaluation of *Cucumis* and *Cucurbita* accessions for resistance to *Phytophthora capsici*, including one request to evaluate all available *Cucumis sativus* accessions (1,291 items). There has also been an increased interest in evaluating cucurbits for downy mildew resistance. The *Ocimum* collection (91 accessions) was distributed to each of two requestors – the first for molecular and phenotypic evaluation; the second for continued research into anti-diabetic properties of basil, and for evaluation of best-management practices for organic basil production. Other vegetable requests received in 2010 included research into *Cucurbita* seed oil, drought and saline tolerance; non-carota *Daucus* species for a pre-breeding program; and a program to isolate genes involved in pigment biosynthesis in *Cucumis sativus*.

Characterization and Taxonomy:
Digital images, and basic notes for taxonomic identification and accession characterization, were recorded during regeneration. Data for approximately 17 descriptors (primarily fruit descriptors) were recorded at harvest for *Cucumis* and *Cucurbita*. Plant habit, flowering dates, and life-cycle notes were recorded for *Daucus*. We loaded 1,875 images taken of 551 vegetable accessions into GRIN, including 128 *Cucumis*, 79 *Cucurbita*, 249 *Daucus*, and 855 *Cichorium* images. (NOTE: Multiple images are taken of an accession to document plant, leaf, flower, fruit, or root characteristics.)

In May 2010, 102 *Daucus* accessions were direct seeded into an observation field to verify taxonomy, collect characterization data and herbarium specimens, and capture digital images of plants, flowers, foliage, and roots. Due to wet conditions in the early spring, ten accessions failed to germinate or had inadequate plant populations. Another six had few or no plants bolt and will be planted as biennials in the 2011 observation plot. Dr. David Spooner (University of Wisconsin, Madison, WI) visited Ames from August 9 to September 2, 2010 to assist with data and herbarium specimen collections. These data, specimens, and images will be used in

his work to develop a monograph for the genus *Daucus*. Dr. Spooner returned to Ames October 9 to 15 to collect data from mature umbels and seeds, and to give a seminar on the ISU campus. The data and images will be loaded into the GRIN database. Thus far, over 3,000 observation records and 287 images have been loaded from the 2010 observation plot. Additional data collected from the 2010 plot will be loaded once descriptors are developed. Another 380 observation records and 319 images were loaded to GRIN from the 2009 *Daucus* observation planting.

With the assistance of Dr. Mark Widrlechner (NCRPIS Horticulturist), taxonomic identities are reviewed and confirmed as each accession is regenerated or grown in observation plots. The 2010 re-identifications included five *Cucumis* accessions to other species within *Cucumis*; 18 *Cucurbita pepo* to one *C. maxima* and 17 *C. moschata*; and 73 *Daucus* to other *Daucus* species, subspecies, or varieties including 11 new *D. capillifolius* accessions and three accessions identified as hybrids of *D. carota* × *D. capillifolius*. The *Cucurbita maxima* was transferred to the Geneva, NY station and the *C. moschata* were transferred to the Griffin, GA station.

The article "Length and Rapid Elongation of Pedicles of the Female Flowers of *Cucumis anguria* L.", by Dr. Mark P. Widrlechner, Kathleen R. Reitsma, and Lucinda D. Clark (NCRPIS, Ames, IA), along with Dr. Joseph H. Kirkbride, Jr. (USDA-ARS, Beltsville, MD) was in the combined Cucurbit Genetics Cooperative Reports 31 & 32 published in 2010. The article documents the variability of pedicle lengths encountered in *Cucumis anguria* germplasm, and revises the key published in Dr. Kirkbride's Biosystematic Monograph of the Genus *Cucumis* (Cucurbitaceae) describing this species.

Evaluation/Utilization:
Dr. Charles Block (NCRPIS Pathologist) continues to screen all *Cucurbita* and *Cucumis* seedlings grown for regeneration for the presence of Squash Mosaic Virus, by using ELISA protocols before seedlings are transplanted to the field. Seedling screening has been done since 1993. He also visually inspects all cucurbit field plantings for disease during the growing season. Seed-borne diseases are of specific interest, with bacterial fruit blotch in *Cucumis melo* being of greatest concern, since phytosanitary issues have prevented the distribution of *Cucumis* germplasm to some countries. Please refer to the Plant Pathology Project section of this report for more information.

The Pollinator Program and the Vegetable Program continued to collaborate on pollinator tests. For more information on this work, please refer to the Entomology section of the annual report.

In 2003, we received oil data on the *Ocimum* collection resulting from an evaluation by Dr. Katerina P. Svoboda and her Ph.D. student, Senga K. Oxenham (formerly Senga K. Kyle) at the Scottish Agricultural College Auchincruive; Department of Plant Science; Ayr, Scotland KA6 5HW, United Kingdom. Oil yields from plants were calculated as percent volume per weight (%v/w) [calculated from the dry weight of leaves only], and essential oils were analyzed by gas liquid chromatography. Final results were recorded for 50 accessions of *O. basilicum* from 13 different geographical locations. (REF: Classification of an *Ocimum* Germplasm Collection (NCRPIS, Ames) and Investigation of Antifungal Activity; Senga K. Oxenham; a

thesis submitted to the Institute of Biomedical and Life Sciences of the University of Glasgow for the degree of PhD (Unpublished).) The descriptors were developed and the oil data loaded to the database in 2010.

Publications/Posters:
Widrlechner, Mark P., Kathleen R. Reitsma, Lucinda D. Clark, and Joseph H. Kirkbride, Jr. 2009. Length and rapid elongation of pedicels of the female flowers of *Cucumis anguria* L. Cucurbit Genetics Cooperative Report 31/32:36-40 and back cover.

Plans for 2011:
Regenerations:
Thirty-seven accessions of *Daucus* from the 2009 collection trip in Tunisia were planted in October 2010 in El Centro, CA by Dr. Phil Simon. The roots were dug from the field March 1, 2011 and shipped to Ames for vernalization. The roots will then be transplanted into field cages for summer 2011 regenerations. Depending upon the status of the station's budget, we will attempt to regenerate approximately 100 *Cucumis* accessions, focusing on accessions that produced insufficient seed quantities in 2009. We will also regenerate approximately 15 *Cucurbita* accessions having low seed quantities. Regenerations of wild *Cucumis* species and hard-to-handle *Cucumis* will continue in the greenhouse as time, space, and other resources permit.

Germinations:
Viability tests will be performed on the 2010 cucurbit regeneration seed lots in April 2011 and on the 2010 *Daucus* regeneration seed lots in the summer of 2011. Ten-year re-germination testing will be done as resources allow.

Characterization:
In October 2010, 60 biennial *Daucus* accessions were sown in pots in the greenhouse. Some of the accessions were included in the 2010 *Daucus* observation planting, but the plants failed to bolt and flower. The roots will be vernalized, then transplanted into an observation field in the spring of 2011 for characterization, taxonomic verification, and herbarium specimens. This plot will be in collaboration with Drs. David Spooner and Philipp Simon (USDA-ARS, University of Wisconsin, Madison, WI) to evaluate diversity in the genus *Daucus*, and to evaluate some of the newly collected populations from the 2009 Tunisia collection trip. The resulting data and images will be loaded into GRIN. These data and images will be useful in Dr. Spooner's work to develop a monograph for the genus *Daucus*.

Review of accession passport data will continue on the cucurbit collections in preparation for assigning PI numbers to many of the Ames-numbered accessions in the collections (414 *Cucumis*, 91 *Cucurbita*, and 99 *Daucus*). Labeling embedded in digital images of these accessions will be updated with the new PI numbers before they are loaded to GRIN.

Evaluation:
Collaboration continues on improving the year-round cage and insect-pollinator program for regenerating vegetable crops.

The Plant Pathology Project will continue to collaborate in monitoring the effectiveness of the cage program in reducing the incidence of and/or delaying the transmission of Squash Mosaic Virus and other insect-vectored diseases of cucurbits. They will also continue the greenhouse survey of the *Cucumis melo* distribution lots for the presence of *Acidovorax avenae* ssp. *citrulli*.

I. Research Leader Activities (C. Gardner)

Administration and Leadership Activities:
C. Gardner administers the five-year project plan objectives for the USDA-ARS Plant Introduction Research Unit's two CRIS Projects, Plant Introduction Research and the Germplasm Enhancement of Maize (GEM) Project, and contributes to the coordination and execution of activities which support those objectives. Gardner serves as the Coordinator of the Hatch-funded Multistate NC7 Project, and as a member of the National Plant Germplasm Coordinating Committee, dedicated to increasing awareness and enhancing the operations of the NPGS across its components. Budgetary anomalies due to shifting Congressional and Agency priorities continue to command more time and resources.

About 15% of her time in 2010 was devoted to assisting GRIN-Global System development team members. Funded in part by the Global Crop Diversity Trust via a grant from the Gates Foundation, and in part by the USDA-ARS through dedication of key personnel, the project's objective is to develop a rational genebank information management system which will be free of recurring license fees, database neutral, and can be used on either stand-alone or networked computers by any genebank in the world. Source code developed as a result of the project will be made freely available. International implementation of the GRIN-Global system is anticipated in 2011, and content of the NPGS' legacy GRIN system will be migrated to the GRIN-Global System in the U.S. in the future.

A second release candidate was delivered to selected genebank personnel for beta testing in the 4th quarter of 2010. During the first half of 2010, a new public interface prototype will be available for testing. Bioversity International provides the expertise for translation of the interface and documentation into several languages and training of international genebank personnel.

Pete Cyr, our Software Applications and Network Systems Information Specialist, serves as the project leader. Other Ames personnel include Mark Millard, our maize curator who serves as systems analyst for the project; Lisa Burke, our seed storage manager who serves as a primary beta tester, and Candice Gardner. NCRPIS development efforts will be primarily devoted to this critically important project for two more years. Together with personnel from the ARS Corvallis, OR, National Clonal Germplasm Repository, the ARS GRIN Database Management Unit (DBMU) personnel, National Program Leader (and Project PI) Peter Bretting, our Global Crop Diversity Trust and Bioversity partners, we look forward to maturation and deployment of the System.

Research Activities:
Graduate student Ivan Ayala-Diaz, a Fulbright Fellow from Colombia, is conducting his Ph.D. research on *Thlaspi* and *Camelina* under the guidance of Dr. Mark Westgate, ISU, and Dr. Gardner, and in collaboration with NCRPIS Oilseeds Curator, Dr. Laura Marek.

Adam Vanous, is working on an M.S. project dealing with GEM Project germplasm and methods to generate dihaploid lines from introgressed maize racial materials.

Andrew Smelser, GEM Project technician, is also working on an M.S. project evaluating the efficacy of the various races for haploid induction and subsequent doubling.

The RL is very involved in the phenotyping / genotyping project for the inbred lines of the maize collection, and was a co-PI and co-author of an unsuccessful AFRI proposal for the maize collection, as well as other grant proposals.

Professional Interactions:
CSSA C8 Division: Chair in 2011, and responsible for the C8 sessions at the annual Crop Science Meetings in San Antonio in October, 2011.

Presentations and Publications:
Srichuwong, S., Gutsea, J., Blanco, M.H., Duvick, S.A., **Gardner, C.A**., Jane, J. 2010. Characterization of corn grains for ethanol production. Journal of ASTM International. 7(2):1-10.

Peter D. Cyr, Candice A. Gardner, Rachelle E. Little, Laura Gu, Brock E. K. Weaver , Mark J. Millard, Gorm P. Emberland, Martin A. Reisinger, Quinn P. Sinnott, Gary R. Kinard, Michael Mackay, Luigi Guarino, Peter K. Bretting. 2010. The GRIN-Global information management system – public interface demonstration and input opportunity. Computer demonstration #C904. Plant and Animal Genomes XIX Conference, San Diego, CA, January 15-19, 2011.

Year 2010 Table 1 **NCRPIS Accessions (Accs), Acquired, Available**

01/01/2010 to 12/31/2010

CURATOR	GENUS_CROP	Number Accs	Number Accs Acquired	Percent Acquired	Number Available	Percent Available	Percent Avail Last Year
Brenner	NC7-amaranth	3346	4	0	3186	95	95
	NC7-celosia	57	2	4	34	60	49
	NC7-echinochloa	306	0	0	257	84	81
	NC7-grasses	125	0	0	76	61	60
	NC7-legumes	237	1	0	110	46	46
	NC7-melilotus	1000	0	0	769	77	77
	NC7-panicum	946	1	0	901	95	97
	NC7-perilla	24	0	0	23	96	96
	NC7-quinoa	350	0	0	217	62	65
	NC7-setaria	1014	0	0	933	92	90
	NC7-spinach	405	3	1	393	97	86
	NC7-umbels	1144	9	1	654	57	55
	Total:	8954	20	0	7553	84	84
Marek	NC7-asters	364	2	1	88	24	24
	NC7-brassica	2006	2	0	1833	91	90
	NC7-crucifers	1144	1	0	980	86	85
	NC7-crucifers.pvp	1	0	0	0	0	0
	NC7-cuphea	639	0	0	512	80	78
	NC7-euphorbia	208	0	0	87	42	36
	NC7-flax	2834	0	0	2820	100	99
	NC7-flax.wilds	120	0	0	91	76	72
	NC7-sun.cults	1809	54	2	1679	93	95
	NC7-sun.wilds.ann	1388	6	0	1312	95	94
	NC7-sun.wilds.per	882	50	6	547	62	60
	NC7-sun.wilds.sp	8	0	0	4	50	45
	Total:	11403	115	1	9953	87	87
Millard	NC7-corn.kin	36	1	3	6	17	18
	NC7-maize.gems	122	15	12	107	88	96
	NC7-maize.inb	2453	54	2	1913	78	74
	NC7-maize.pop	17077	0	0	11052	65	65
	NC7-maize.pvp	256	46	18	226	88	92
	NC7-maize.wilds	439	63	14	90	21	24
	Zea.totals	20347	178	1	13388	66	66
	Total:	20383	179	1	13394	66	65
Qu	NC7-medicinals	494	5	1	323	65	64
	Total:	494	5	1	323	66	64
Reitsma	NC7-chicory	276	0	0	219	79	83
	NC7-cucumis.cucs	1374	0	0	1296	94	94
	NC7-cucumis.melo	3196	1	0	2257	71	71
	NC7-cucumis.wilds	321	0	0	167	52	50
	NC7-cucurbita	980	0	0	761	78	78
	NC7-daucus	1271	45	4	982	77	80
	NC7-ocimum	98	0	0	91	93	93
	NC7-parsnips	71	0	0	51	72	73
	Total:	7587	46	1	5824	77	78
Widrlechner	NC7-mints	155	2	1	114	74	70
	NC7-ornamentals	2417	107	4	1112	46	46
	Total:	2572	109	4	1226	48	47
NCRPIS Total:		**51393**	**474**	**1**	**38273**	**74**	**74**

Year 2010 Table 2 NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up

01/01/2010 to 12/31/2010

CURATOR	GENUS_CROP	Number Accs	Number Accs Germed	Percent Accs Germed	Number Attempted Regen	Number Harvested Regen	Number Perm Perennial	Number Perennial Harvested (Vegetative)	Number Accs Made Available	Number Accs Growing	Number Accs Backed UP for YR	Total Number Accs Backed Up	Percent Accs Backed Up
Brenner	NC7-amaranth	3346	62	2	41	2	0	0	4	0	279	3213	96
	NC7-celosia	57	5	9	1	1	0	0	8	0	6	35	61
	NC7-echinochloa	306	0	0	1	1	0	0	9	0	7	264	86
	NC7-grasses	125	1	1	0	0	0	0	0	0	2	83	66
	NC7-legumes	237	1	0	1	2	0	0	2	0	1	175	74
	NC7-melilotus	1000	0	0	30	29	0	0	0	0	101	843	84
	NC7-panicum	946	0	0	9	0	0	0	2	0	2	917	97
	NC7-perilla	24	1	4	0	0	0	0	1	0	0	23	96
	NC7-quinoa	350	1	0	4	2	0	0	1	0	26	250	71
	NC7-setaria	1014	0	0	7	3	0	0	26	0	18	966	95
	NC7-spinach	405	111	27	5	34	0	0	109	0	176	391	97
	NC7-umbels	1144	43	4	14	25	0	0	33	0	29	672	59
	Total:	8954	225	3	113	99	0	0	195	0	647	7832	87
Marek	NC7-asters	364	1	0	0	0	0	0	1	0	1	99	27
	NC7-brassica	2006	28	1	29	28	0	0	34	4	222	1966	98
	NC7-crucifers	1144	17	1	44	20	0	1	15	15	92	1006	88
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	1	100
	NC7-cuphea	639	4	1	18	3	0	0	5	16	4	584	91
	NC7-euphorbia	208	10	5	17	9	0	0	10	5	7	84	40
	NC7-flax	2834	176	6	1	1	0	0	1	0	117	2832	100
	NC7-flax.wilds	120	5	4	1	2	0	0	5	1	5	91	76
	NC7-sun.cults	1809	41	2	58	52	0	0	65	0	32	1736	96
	NC7-sun.wilds.ann	1388	31	2	16	15	0	0	32	15	21	1323	95
	NC7-sun.wilds.per	882	49	6	89	64	18	0	55	73	42	550	62
	NC7-sun.wilds.sp	8	0	0	0	0	0	0	0	0	0	5	63
	Total:	11403	362	3	273	194	18	1	223	129	543	10277	90
Millard	NC7-corn.kin	36	2	6	0	0	0	0	1	0	0	9	25
	NC7-maize.gems	122	5	4	0	5	0	0	4	0	4	71	58
	NC7-maize.inb	2453	205	8	185	208	0	0	184	0	80	1541	63
	NC7-maize.pop	17077	650	4	291	291	0	0	102	0	3	13104	77
	NC7-maize.pvp	256	122	48	61	59	0	0	103	0	16	256	100
	NC7-maize.wilds	439	0	0	0	0	0	0	1	5	0	44	10
	Zea.totals	20347	982	5	537	563	0	0	394	5	103	15016	74
	Total:	20383	984	5	537	563	0	0	395	5	103	15025	74
Qu	NC7-medicinals	494	37	7	79	53	99	0	30	0	23	338	68
	Total:	494	37	7	79	53	99	0	30	0	23	338	68
Reitsma	NC7-chicory	276	0	0	0	0	0	0	0	0	0	243	88
	NC7-cucumis.cucs	1374	2	0	31	29	0	0	11	0	177	1298	94
	NC7-cucumis.melo	3196	707	22	64	55	0	0	48	0	483	2536	79
	NC7-cucumis.wilds	321	17	5	18	14	0	0	16	0	27	170	53
	NC7-cucurbita	980	14	1	15	11	0	0	12	0	195	814	83
	NC7-daucus	1271	105	8	19	51	0	0	7	0	18	999	79
	NC7-ocimum	98	0	0	0	0	0	0	0	0	0	91	93
	NC7-parsnips	71	0	0	0	0	0	0	0	0	33	48	68
	Total:	7587	845	11	147	160	0	0	94	0	933	6199	82
Widrlechner	NC7-mints	155	9	6	0	0	0	0	7	0	5	118	76
	NC7-ornamentals	2417	109	5	54	101	43	14	91	0	134	1003	41
	Total:	2572	118	5	54	101	43	14	98	0	139	1121	44
NCRPIS Total:		**51393**	**2571**	**5**	**1203**	**1170**	**160**	**15**	**1035**	**134**	**2388**	**40792**	**79**

Year 2010 Table 3A-1 **External NCRPIS Distributions** - Includes both DI (research and education) and NR (home gardner) order types

01/01/2010 to 12/31/2010

			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	GENUS_CROP	Number Accs in Collection	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items
Brenner	NC7-amaranth	3346	221	35	31	295	291	16	16	346	437	51	47	641
	NC7-celosia	57	2	3	3	4	1	1	1	1	3	4	4	5
	NC7-echinochloa	306	10	7	7	15	25	4	4	33	31	11	11	48
	NC7-grasses	125	2	3	3	4	3	2	2	3	4	5	5	7
	NC7-legumes	237	15	8	8	16	11	3	3	11	24	11	11	27
	NC7-melilotus	1000	113	18	15	149	31	7	6	32	139	25	21	181
	NC7-panicum	946	13	13	12	17	208	6	6	212	211	19	18	229
	NC7-perilla	24	23	5	5	26	23	2	2	42	23	7	7	68
	NC7-quinoa	350	139	46	40	356	108	17	16	182	173	63	56	538
	NC7-setaria	1014	114	19	18	159	190	8	7	196	265	27	25	355
	NC7-spinach	405	354	14	13	578	265	0	0	285	361	14	13	863
	NC7-umbels	1144	205	32	28	298	12	6	5	12	214	38	33	310
	Total:	8954	1211	203	183	1917	1168	72	68	1355	1885	275	251	3272
Marek	NC7-asters	364	16	13	11	23	9	6	6	12	22	19	17	35
	NC7-brassica	2006	1068	41	36	1295	444	31	29	558	1238	72	65	1853
	NC7-crucifers	1144	190	46	37	389	289	25	24	353	387	71	61	742
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	639	91	8	6	97	2	2	2	2	91	10	8	99
	NC7-euphorbia	208	10	5	5	13	5	1	1	5	14	6	6	18
	NC7-flax	2834	45	13	13	53	67	3	3	69	112	16	16	122
	NC7-flax.wilds	120	28	1	1	28	9	1	1	9	36	2	2	37
	NC7-sun.cults	1809	703	64	47	1181	997	34	27	1311	1382	98	74	2492
	NC7-sun.wilds.ann	1388	82	38	33	107	339	18	16	418	375	56	49	525
	NC7-sun.wilds.per	882	97	15	13	108	246	6	6	264	302	21	19	372
	NC7-sun.wilds.sp	8	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	11403	2330	244	202	3294	2407	127	115	3001	3959	371	317	6295
Millard	NC7-corn.kin	36	5	5	5	9	6	2	2	7	7	7	7	16
	NC7-maize.gems	122	87	18	16	217	45	4	4	55	102	22	20	272
	NC7-maize.inb	2453	1582	235	174	4047	436	44	39	649	1610	279	213	4696
	NC7-maize.pop	17077	1661	232	192	2374	267	23	20	289	1791	255	212	2663
	NC7-maize.pvp	256	229	203	119	3781	178	24	22	567	229	227	141	4348
	NC7-maize.wilds	439	93	47	39	198	13	4	3	15	93	51	42	213
	Zea.totals	20347	3652	570	386	10617	939	71	61	1575	3825	641	447	12192
	Total:	20383	3657	575	391	10626	945	73	63	1582	3832	648	454	12208
Qu	NC7-medicinals	494	126	32	28	151	13	3	3	14	129	35	31	165
	Total:	494	126	32	28	151	13	3	3	14	129	35	31	165
Reitsma	NC7-chicory	276	56	7	6	57	11	4	3	12	61	11	9	69
	NC7-cucumis.cucs	1374	1295	44	37	1934	460	26	25	709	1299	70	62	2643
	NC7-cucumis.melo	3196	532	41	37	632	300	14	14	353	728	55	51	985
	NC7-cucumis.wilds	321	18	8	8	20	110	6	6	130	113	14	14	150
	NC7-cucurbita	980	369	39	37	481	241	25	24	406	485	64	61	887
	NC7-daucus	1271	226	31	30	273	132	6	6	139	337	37	36	412
	NC7-ocimum	98	91	20	19	162	17	2	2	17	91	22	21	179
	NC7-parsnips	71	13	3	3	15	15	2	2	16	25	5	5	31
	Total:	7587	2600	193	177	3574	1286	85	82	1782	3139	278	259	5356
Widrlechner	NC7-mints	155	33	19	19	49	5	3	3	5	34	22	22	54
	NC7-ornamentals	2417	187	69	62	220	80	13	11	81	248	82	73	301
	Total:	2572	220	88	81	269	85	16	14	86	282	104	95	355
NCRPIS Total:		**51393**	**10144**	**1002**	**705**	**19831**	**5904**	**277**	**238**	**7820**	**13226**	**1279**	**943**	**27651**

Year 2010 Table 3A-2 NCRPIS Home Gardner Distributions

01/01/2010 to 12/31/2010

			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	**GENUS_CROP**	**Number Accs in Collection**	**Number Accs**	**Number Orders**	**Number Recipients**	**Number Items**	**Number Accs**	**Number Orders**	**Number Recipients**	**Number Items**	**Number Accs**	**Number Orders**	**Number Recipients**	**Number Items**
Brenner	NC7-amaranth	3346	6	4	4	6	3	1	1	3	9	5	5	9
	NC7-celosia	57	1	1	1	1	0	0	0	0	1	1	1	1
	NC7-echinochloa	306	3	2	2	3	0	0	0	0	3	2	2	3
	NC7-grasses	125	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-legumes	237	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-melilotus	1000	3	3	3	3	1	1	1	1	3	4	4	4
	NC7-panicum	946	1	1	1	1	0	0	0	0	1	1	1	1
	NC7-perilla	24	1	1	1	1	0	0	0	0	1	1	1	1
	NC7-quinoa	350	7	6	6	9	2	1	1	2	8	7	7	11
	NC7-setaria	1014	2	1	1	2	0	0	0	0	2	1	1	2
	NC7-spinach	405	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-umbels	1144	21	14	14	22	2	1	1	2	23	15	15	24
	Total:	8954	45	33	33	48	8	4	4	8	51	37	37	56
Marek	NC7-asters	364	3	3	3	3	0	0	0	0	3	3	3	3
	NC7-brassica	2006	7	5	5	8	0	0	0	0	7	5	5	8
	NC7-crucifers	1144	4	5	5	6	1	1	1	1	4	6	6	7
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	639	1	1	1	1	0	0	0	0	1	1	1	1
	NC7-euphorbia	208	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-flax	2834	3	3	3	3	0	0	0	0	3	3	3	3
	NC7-flax.wilds	120	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.cults	1809	23	17	17	27	0	0	0	0	23	17	17	27
	NC7-sun.wilds.ann	1388	2	6	6	6	0	0	0	0	2	6	6	6
	NC7-sun.wilds.per	882	2	2	2	2	0	0	0	0	2	2	2	2
	NC7-sun.wilds.sp	8	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	11403	45	42	42	56	1	1	1	1	45	43	43	57
Millard	NC7-corn.kin	36	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-maize.gems	122	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-maize.inb	2453	11	6	6	11	0	0	0	0	11	6	6	11
	NC7-maize.pop	17077	138	49	49	162	0	0	0	0	138	49	49	162
	NC7-maize.pvp	256	5	5	5	10	0	0	0	0	5	5	5	10
	NC7-maize.wilds	439	1	1	1	1	0	0	0	0	1	1	1	1
	Zea.totals	20347	155	54	54	184	0	0	0	0	155	54	54	184
	Total:	20383	155	54	54	184	0	0	0	0	155	54	54	184
Qu	NC7-medicinals	494	21	10	10	24	1	1	1	1	22	11	11	25
	Total:	494	21	10	10	24	1	1	1	1	22	11	11	25
Reitsma	NC7-chicory	276	2	2	2	2	0	0	0	0	2	2	2	2
	NC7-cucumis.cucs	1374	47	20	20	58	0	0	0	0	47	20	20	58
	NC7-cucumis.melo	3196	33	15	15	38	2	1	1	2	33	16	16	40
	NC7-cucumis.wilds	321	3	3	3	3	0	0	0	0	3	3	3	3
	NC7-cucurbita	980	26	17	17	40	11	1	1	11	35	18	18	51
	NC7-daucus	1271	43	17	17	56	3	1	1	3	44	18	18	59
	NC7-ocimum	98	14	11	11	21	1	1	1	1	14	12	12	22
	NC7-parsnips	71	7	2	2	7	4	1	1	4	11	3	3	11
	Total:	7587	175	87	87	225	21	5	5	21	189	92	92	246
Widrlechner	NC7-mints	155	19	14	14	24	0	0	0	0	19	14	14	24
	NC7-ornamentals	2417	22	14	14	24	0	0	0	0	22	14	14	24
	Total:	2572	41	28	28	48	0	0	0	0	41	28	28	48
NCRPIS Total:		**51393**	**482**	**124**	**124**	**585**	**31**	**2**	**2**	**31**	**503**	**126**	**126**	**616**

Year 2010 Table 3B **Internal NCRPIS Distributions**

01/01/2010 to 12/31/2010

			NC7 Related (# Accs)							Seed Storage Maintenance	
CURATOR	GENUS_CROP	Number Accs	Backed Up	Germed	Obs	Regen	Path Test	Total	# Distinct Accs for NC7 Orders	# Accs Stored	# Accs Ct Rev
Brenner	NC7-amaranth	3346	279	1	25	3	0	308	305	1	215
	NC7-celosia	57	6	5	0	1	0	12	9	9	0
	NC7-echinochloa	306	7	0	0	0	0	7	7	12	7
	NC7-grasses	125	2	1	0	0	0	3	2	1	0
	NC7-legumes	237	1	1	0	3	0	5	5	6	0
	NC7-melilotus	1000	101	0	0	30	0	131	131	4	95
	NC7-panicum	946	2	0	0	0	0	2	2	2	1
	NC7-perilla	24	0	1	0	0	0	1	1	1	1
	NC7-quinoa	350	26	1	0	0	0	27	26	1	28
	NC7-setaria	1014	18	0	0	0	0	18	18	42	12
	NC7-spinach	405	176	111	0	2	0	289	185	113	18
	NC7-umbels	1144	29	45	22	13	0	109	77	45	123
	Total:	8954	647	166	47	52	0	912	768	237	500
Marek	NC7-asters	364	1	1	0	0	0	2	1	2	0
	NC7-brassica	2006	222	28	9	29	0	288	266	33	96
	NC7-crucifers	1144	92	17	49	29	0	187	166	29	72
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0
	NC7-cuphea	639	4	4	0	3	0	11	7	6	12
	NC7-euphorbia	208	7	10	0	12	0	29	19	10	0
	NC7-flax	2834	117	1	0	1	0	119	118	1	113
	NC7-flax.wilds	120	5	5	0	0	0	10	5	6	0
	NC7-sun.cults	1809	32	41	1	59	0	133	98	90	139
	NC7-sun.wilds.ann	1388	21	31	63	22	0	137	111	43	23
	NC7-sun.wilds.per	882	42	49	98	54	30	273	203	97	8
	NC7-sun.wilds.sp	8	0	0	0	1	0	1	1	0	1
	Total:	11403	543	187	220	210	30	1190	995	317	464
Millard	NC7-corn.kin	36	0	1	1	0	0	2	1	2	1
	NC7-maize.gems	122	4	5	38	0	2	49	40	4	6
	NC7-maize.inb	2453	80	188	2022	190	22	2502	2103	247	190
	NC7-maize.pop	17077	3	591	16	437	108	1155	1126	130	383
	NC7-maize.pvp	256	16	66	182	74	1	339	232	123	118
	NC7-maize.wilds	439	0	0	1	0	0	1	1	1	11
	Zea.totals	20347	103	850	2259	701	133	4046	3502	505	708
	Total:	20383	103	851	2260	701	133	4048	3503	507	709
Qu	NC7-medicinals	494	23	37	45	34	3	142	91	37	7
	Total:	494	23	37	45	34	3	142	91	37	7
Reitsma	NC7-chicory	276	0	0	0	0	0	0	0	0	0
	NC7-cucumis.cucs	1374	177	2	0	31	0	210	208	12	69
	NC7-cucumis.melo	3196	483	707	0	63	11	1264	1030	58	451
	NC7-cucumis.wilds	321	27	17	0	15	0	59	44	18	14
	NC7-cucurbita	980	195	14	6	15	1	231	221	14	151
	NC7-daucus	1271	18	104	187	28	0	337	299	80	6
	NC7-ocimum	98	0	0	0	0	0	0	0	0	2
	NC7-parsnips	71	33	0	0	0	0	33	33	0	1
	Total:	7587	933	844	193	152	12	2134	1835	182	694
Widrlechner	NC7-mints	155	5	9	0	0	0	14	9	12	2
	NC7-ornamentals	2417	134	67	0	8	0	209	205	168	60
	Total:	2572	139	76	0	8	0	223	214	180	62
NCRPIS Total:		**51393**	**2388**	**2161**	**2765**	**1157**	**178**	**8649**	**7406**	**1460**	**2436**

Year 2010 Table 4 **NCRPIS Accessions (Accs) Observations (Obs) in GRIN, Images in GRIN**

01/01/2010 to 12/31/2010

CURATOR	GENUS_CROP	Number Accs	Number Accs Obs Trials	Number Obs in GRIN for Year	Number Acc Obs in GRIN for Year	Number Acc Obs in GRIN Last Year	Number Acc Obs in GRIN (all years)	Number Accs Imaged	Number Acc Images in GRIN for Year	Number Acc Images in GRIN (all years)
Brenner	NC7-amaranth	3346	25	366	255	21	3339	30	257	619
	NC7-celosia	57	0	9	7	0	16	2	7	15
	NC7-echinochloa	306	0	38	31	0	303	0	31	49
	NC7-grasses	125	0	8	7	0	17	1	7	18
	NC7-legumes	237	0	4	2	0	89	4	2	6
	NC7-melilotus	1000	0	48	43	349	975	35	44	77
	NC7-panicum	946	0	108	58	0	940	0	58	80
	NC7-perilla	24	0	0	0	0	0	0	5	6
	NC7-quinoa	350	0	66	63	0	299	2	63	101
	NC7-setaria	1014	0	411	182	0	999	18	109	125
	NC7-spinach	405	0	20	11	0	401	3	11	11
	NC7-umbels	1144	22	168	117	1	323	36	118	129
	Total:	8954	47	1246	776	371	7701	131	712	1236
Marek	NC7-asters	364	0	0	0	0	4	1	0	9
	NC7-brassica	2006	9	1	1	41	1901	5	1	333
	NC7-crucifers	1144	49	0	0	43	821	17	0	334
	NC7-crucifers.pvp	1	0	0	0	0	1	0	0	0
	NC7-cuphea	639	0	3	3	2	368	0	3	13
	NC7-euphorbia	208	0	0	0	0	0	0	0	0
	NC7-flax	2834	0	3	1	8	2825	0	0	1
	NC7-flax.wilds	120	0	0	0	0	82	1	0	6
	NC7-sun.cults	1809	1	1388	43	115	1682	84	42	98
	NC7-sun.wilds.ann	1388	63	442	31	35	1280	10	11	57
	NC7-sun.wilds.per	882	98	694	53	63	570	49	21	108
	NC7-sun.wilds.sp	8	0	42	3	0	7	0	1	1
	Total:	11403	220	2573	135	307	9541	167	79	960
Millard	NC7-corn.kin	36	1	0	0	0	0	0	0	0
	NC7-maize.gems	122	38	127	4	31	112	4	0	103
	NC7-maize.inb	2453	2022	4305	496	158	2223	293	0	588
	NC7-maize.pop	17077	16	2549	256	522	14454	119	31	4202
	NC7-maize.pvp	256	182	1236	129	81	230	104	20	188
	NC7-maize.wilds	439	1	0	0	29	264	0	0	107
	Zea.totals	20347	2259	8217	885	821	17283	520	51	5188
	Total:	20383	2260	8217	885	821	17283	520	51	5188
Qu	NC7-medicinals	494	45	0	0	4	291	5	0	269
	Total:	494	45	0	0	4	291	5	0	269
Reitsma	NC7-chicory	276	0	831	242	27	276	0	242	244
	NC7-cucumis.cucs	1374	0	42	32	14	1363	29	32	873
	NC7-cucumis.melo	3196	0	23	18	11	3113	51	18	461
	NC7-cucumis.wilds	321	0	0	0	0	286	14	41	42
	NC7-cucurbita	980	6	41	18	92	974	13	18	107
	NC7-daucus	1271	187	4244	258	0	1160	162	200	207
	NC7-ocimum	98	0	306	73	0	98	0	0	0
	NC7-parsnips	71	0	0	0	0	70	0	0	0
	Total:	7587	193	5487	641	144	7340	269	551	1934
Widrlechner	NC7-mints	155	0	0	0	0	26	1	0	31
	NC7-ornamentals	2417	4	198	90	151	706	100	89	739
	Total:	2572	4	198	90	151	732	101	89	770
NCRPIS Total:		**51393**	**2769**	**17721**	**2527**	**1798**	**42888**	**1193**	**1482**	**10357**

Year 2010 Table 5 **Five-Year Summary of NCRPIS Accession Orders by Crop**

Includes both DI (research and education) and NR (home gardner) order types

CURATOR	GENUS_CROP	TIME_PERIOD	Number Orders	Number Recipients	Number Items Distributed	Number Accessions Distributed
Brenner	NC7-amaranth	01/01/2006 - 12/31/2006	59	53	3230	2630
		01/01/2007 - 12/31/2007	56	50	532	310
		01/01/2008 - 12/31/2008	52	51	446	291
		01/01/2009 - 12/31/2009	71	67	874	540
		01/01/2010 - 12/31/2010	51	47	641	437
	Total:		289	268	5723	4208
	NC7-celosia	01/01/2006 - 12/31/2006	9	8	31	21
		01/01/2007 - 12/31/2007	8	8	35	21
		01/01/2008 - 12/31/2008	4	4	9	8
		01/01/2009 - 12/31/2009	13	12	25	16
		01/01/2010 - 12/31/2010	4	4	5	3
	Total:		38	36	105	69
	NC7-echinochloa	01/01/2006 - 12/31/2006	19	16	49	24
		01/01/2007 - 12/31/2007	5	5	15	14
		01/01/2008 - 12/31/2008	5	4	13	12
		01/01/2009 - 12/31/2009	9	9	60	51
		01/01/2010 - 12/31/2010	11	11	48	31
	Total:		49	45	185	132
	NC7-grasses	01/01/2006 - 12/31/2006	7	6	9	7
		01/01/2007 - 12/31/2007	2	2	6	5
		01/01/2008 - 12/31/2008	2	2	5	5
		01/01/2009 - 12/31/2009	1	1	1	1
		01/01/2010 - 12/31/2010	5	5	7	4
	Total:		17	16	28	22
	NC7-legumes	01/01/2006 - 12/31/2006	6	6	15	11
		01/01/2007 - 12/31/2007	2	2	9	9
		01/01/2008 - 12/31/2008	11	10	86	78
		01/01/2009 - 12/31/2009	15	14	32	22
		01/01/2010 - 12/31/2010	11	11	27	24
	Total:		45	43	169	144
	NC7-melilotus	01/01/2006 - 12/31/2006	12	10	56	49
		01/01/2007 - 12/31/2007	12	11	41	27
		01/01/2008 - 12/31/2008	20	15	411	268
		01/01/2009 - 12/31/2009	23	19	276	218
		01/01/2010 - 12/31/2010	25	21	181	139
	Total:		92	76	965	701
	NC7-panicum	01/01/2006 - 12/31/2006	22	21	77	42
		01/01/2007 - 12/31/2007	11	10	21	20
		01/01/2008 - 12/31/2008	18	18	150	115
		01/01/2009 - 12/31/2009	20	20	228	159
		01/01/2010 - 12/31/2010	19	18	229	211
	Total:		90	87	705	547
	NC7-perilla	01/01/2006 - 12/31/2006	14	14	102	22
		01/01/2007 - 12/31/2007	6	6	21	14
		01/01/2008 - 12/31/2008	5	5	44	19
		01/01/2009 - 12/31/2009	14	14	64	23
		01/01/2010 - 12/31/2010	7	7	68	23
	Total:		46	46	299	101

	NC7-quinoa	01/01/2006 - 12/31/2006	37	31	401	196
		01/01/2007 - 12/31/2007	40	37	307	128
		01/01/2008 - 12/31/2008	50	45	296	132
		01/01/2009 - 12/31/2009	57	54	575	223
		01/01/2010 - 12/31/2010	63	56	538	173
	Total:		247	223	2117	852
	NC7-setaria	01/01/2006 - 12/31/2006	23	21	227	177
		01/01/2007 - 12/31/2007	16	16	317	225
		01/01/2008 - 12/31/2008	24	24	316	249
		01/01/2009 - 12/31/2009	16	16	145	104
		01/01/2010 - 12/31/2010	27	25	355	265
	Total:		106	102	1360	1020
	NC7-spinach	01/01/2006 - 12/31/2006	26	26	1619	377
		01/01/2007 - 12/31/2007	19	18	1196	374
		01/01/2008 - 12/31/2008	26	23	668	361
		01/01/2009 - 12/31/2009	34	31	527	351
		01/01/2010 - 12/31/2010	23	21	863	361
	Total:		128	119	4873	1824
	NC7-umbels	01/01/2006 - 12/31/2006	36	33	189	136
		01/01/2007 - 12/31/2007	30	29	199	164
		01/01/2008 - 12/31/2008	30	29	463	313
		01/01/2009 - 12/31/2009	64	60	460	276
		01/01/2010 - 12/31/2010	38	33	310	214
	Total:		198	184	1621	1103
	Brenner Total:		1345	1245	18150	10723
Marek	NC7-asters	01/01/2006 - 12/31/2006	14	12	61	54
		01/01/2007 - 12/31/2007	7	6	16	16
		01/01/2008 - 12/31/2008	14	13	30	20
		01/01/2009 - 12/31/2009	14	11	41	31
		01/01/2010 - 12/31/2010	19	17	35	22
	Total:		68	59	183	143
	NC7-brassica	01/01/2006 - 12/31/2006	70	56	2532	1421
		01/01/2007 - 12/31/2007	64	49	1754	1047
		01/01/2008 - 12/31/2008	74	64	1866	1233
		01/01/2009 - 12/31/2009	81	75	1694	1037
		01/01/2010 - 12/31/2010	72	65	1853	1238
	Total:		361	309	9699	5976
	NC7-crucifers	01/01/2006 - 12/31/2006	34	32	358	208
		01/01/2007 - 12/31/2007	48	43	839	412
		01/01/2008 - 12/31/2008	59	50	658	520
		01/01/2009 - 12/31/2009	56	54	555	389
		01/01/2010 - 12/31/2010	71	61	742	387
	Total:		268	240	3152	1916
	NC7-crucifers.pvp	01/01/2006 - 12/31/2006	0	0	0	0
		01/01/2007 - 12/31/2007	0	0	0	0
		01/01/2008 - 12/31/2008	0	0	0	0
		01/01/2009 - 12/31/2009	0	0	0	0
		01/01/2010 - 12/31/2010	0	0	0	0
	Total:		0	0	0	0
	NC7-cuphea	01/01/2006 - 12/31/2006	21	16	337	254
		01/01/2007 - 12/31/2007	19	10	720	507
		01/01/2008 - 12/31/2008	18	15	98	81
		01/01/2009 - 12/31/2009	27	22	138	107
		01/01/2010 - 12/31/2010	10	8	99	91
	Total:		95	71	1392	1040

	NC7-euphorbia	01/01/2006 - 12/31/2006	4	4	15	13
		01/01/2007 - 12/31/2007	4	3	10	8
		01/01/2008 - 12/31/2008	7	6	85	83
		01/01/2009 - 12/31/2009	8	6	35	29
		01/01/2010 - 12/31/2010	6	6	18	14
	Total:		29	25	163	147
	NC7-flax	01/01/2006 - 12/31/2006	19	18	1284	1199
		01/01/2007 - 12/31/2007	8	8	60	56
		01/01/2008 - 12/31/2008	16	16	243	230
		01/01/2009 - 12/31/2009	22	19	120	111
		01/01/2010 - 12/31/2010	16	16	122	112
	Total:		81	77	1829	1708
	NC7-flax.wilds	01/01/2006 - 12/31/2006	8	8	138	65
		01/01/2007 - 12/31/2007	4	3	19	19
		01/01/2008 - 12/31/2008	6	6	24	22
		01/01/2009 - 12/31/2009	9	8	36	30
		01/01/2010 - 12/31/2010	2	2	37	36
	Total:		29	27	254	172
	NC7-sun.cults	01/01/2006 - 12/31/2006	56	44	468	346
		01/01/2007 - 12/31/2007	64	47	755	542
		01/01/2008 - 12/31/2008	83	68	1673	985
		01/01/2009 - 12/31/2009	96	82	757	550
		01/01/2010 - 12/31/2010	98	74	2492	1382
	Total:		397	315	6145	3805
	NC7-sun.wilds	01/01/2006 - 12/31/2006	45	40	1072	648
		01/01/2007 - 12/31/2007	42	38	1302	1106
		01/01/2008 - 12/31/2008	58	52	1059	754
		01/01/2009 - 12/31/2009	67	60	822	572
		01/01/2010 - 12/31/2010	70	61	897	677
	Total:		282	251	5152	3757
	Marek Total:		1610	1374	27969	18664
Millard	NC7-corn.kin	01/01/2006 - 12/31/2006	16	14	34	6
		01/01/2007 - 12/31/2007	14	14	28	6
		01/01/2008 - 12/31/2008	15	15	25	6
		01/01/2009 - 12/31/2009	10	10	21	7
		01/01/2010 - 12/31/2010	7	7	16	7
	Total:		62	60	124	32
	NC7-maize.gems	01/01/2006 - 12/31/2006	28	25	334	66
		01/01/2007 - 12/31/2007	23	22	381	67
		01/01/2008 - 12/31/2008	27	23	329	81
		01/01/2009 - 12/31/2009	25	18	324	87
		01/01/2010 - 12/31/2010	22	20	272	102
	Total:		125	108	1640	403
	NC7-maize.inb	01/01/2006 - 12/31/2006	265	197	2956	760
		01/01/2007 - 12/31/2007	259	203	3314	919
		01/01/2008 - 12/31/2008	271	210	5216	1634
		01/01/2009 - 12/31/2009	311	238	3721	1040
		01/01/2010 - 12/31/2010	279	213	4696	1610
	Total:		1385	1061	19903	5963
	NC7-maize.pop	01/01/2006 - 12/31/2006	195	163	2132	1463
		01/01/2007 - 12/31/2007	207	174	1722	1016
		01/01/2008 - 12/31/2008	234	191	2338	1547
		01/01/2009 - 12/31/2009	319	276	3928	2810
		01/01/2010 - 12/31/2010	255	212	2663	1791
	Total:		1210	1016	12783	8627

	NC7-maize.pvp	01/01/2006 - 12/31/2006	214	95	2202	111
		01/01/2007 - 12/31/2007	188	106	3181	130
		01/01/2008 - 12/31/2008	190	107	2340	153
		01/01/2009 - 12/31/2009	236	125	3754	194
		01/01/2010 - 12/31/2010	227	141	4348	229
		Total:	1055	574	15825	817
	NC7-maize.wilds	01/01/2006 - 12/31/2006	59	49	303	77
		01/01/2007 - 12/31/2007	67	62	272	43
		01/01/2008 - 12/31/2008	60	58	201	42
		01/01/2009 - 12/31/2009	64	55	313	149
		01/01/2010 - 12/31/2010	51	42	213	93
		Total:	301	266	1302	404
	Zea.totals	01/01/2006 - 12/31/2006	585	356	7927	2477
		01/01/2007 - 12/31/2007	553	376	8870	2175
		01/01/2008 - 12/31/2008	601	406	10424	3457
		01/01/2009 - 12/31/2009	768	522	12041	4280
		01/01/2010 - 12/31/2010	641	447	12192	3825
		Total:	3148	2107	51454	16214
		Millard Total:	3210	2167	51578	16246
Qu	NC7-medicinals	01/01/2006 - 12/31/2006	44	35	323	163
		01/01/2007 - 12/31/2007	58	48	358	181
		01/01/2008 - 12/31/2008	34	31	232	161
		01/01/2009 - 12/31/2009	63	51	266	153
		01/01/2010 - 12/31/2010	35	31	165	129
		Qu Total:	234	196	1344	787
Reitsma	NC7-chicory	01/01/2006 - 12/31/2006	10	9	44	38
		01/01/2007 - 12/31/2007	5	5	203	162
		01/01/2008 - 12/31/2008	13	11	230	146
		01/01/2009 - 12/31/2009	19	18	35	26
		01/01/2010 - 12/31/2010	11	9	69	61
		Total:	58	52	581	433
	NC7-cucumis	01/01/2006 - 12/31/2006	126	108	3970	2096
		01/01/2007 - 12/31/2007	115	94	3368	1866
		01/01/2008 - 12/31/2008	121	106	3583	2033
		01/01/2009 - 12/31/2009	215	195	3881	2452
		01/01/2010 - 12/31/2010	117	102	3778	2140
		Total:	694	605	18580	10587
	NC7-cucurbita	01/01/2006 - 12/31/2006	58	52	424	300
		01/01/2007 - 12/31/2007	41	36	525	323
		01/01/2008 - 12/31/2008	71	65	436	248
		01/01/2009 - 12/31/2009	114	108	1571	817
		01/01/2010 - 12/31/2010	64	61	887	485
		Total:	348	322	3843	2173
	NC7-daucus	01/01/2006 - 12/31/2006	33	32	460	356
		01/01/2007 - 12/31/2007	24	21	330	284
		01/01/2008 - 12/31/2008	29	26	684	475
		01/01/2009 - 12/31/2009	83	79	802	491
		01/01/2010 - 12/31/2010	37	36	412	337
		Total:	206	194	2688	1943
	NC7-ocimum	01/01/2006 - 12/31/2006	21	21	123	69
		01/01/2007 - 12/31/2007	11	10	68	51
		01/01/2008 - 12/31/2008	20	19	137	91
		01/01/2009 - 12/31/2009	39	37	442	91
		01/01/2010 - 12/31/2010	22	21	179	91
		Total:	113	108	949	393

	NC7-parsnips	01/01/2006 - 12/31/2006	3	3	22	15
		01/01/2007 - 12/31/2007	3	3	8	8
		01/01/2008 - 12/31/2008	2	2	6	6
		01/01/2009 - 12/31/2009	11	11	80	46
		01/01/2010 - 12/31/2010	5	5	31	25
	Total:		24	24	147	100
	Reitsma Total:		1443	1305	26788	15629
Widrlechner	NC7-mints	01/01/2006 - 12/31/2006	19	19	55	37
		01/01/2007 - 12/31/2007	10	10	54	47
		01/01/2008 - 12/31/2008	14	14	88	64
		01/01/2009 - 12/31/2009	32	30	178	91
		01/01/2010 - 12/31/2010	22	22	54	34
	Total:		97	95	429	273
	NC7-ornamentals	01/01/2006 - 12/31/2006	87	74	427	315
		01/01/2007 - 12/31/2007	75	71	264	193
		01/01/2008 - 12/31/2008	88	82	336	245
		01/01/2009 - 12/31/2009	109	94	578	364
		01/01/2010 - 12/31/2010	82	73	301	248
	Total:		441	394	1906	1365
	Widrlechner Total:		538	489	2335	1638
NCRPIS Total:			**8380**	**6776**	**128164**	**63687**

Table 6a **NC7 NIFA Regional Order History**

TIME_PERIOD	Total Number of Orders	Number of Orders (DI)	Foreign Orders (DI)	Domestic Orders (DI)	Domestic Orders (DI) NIFA Regions NC7	NE9	S9	W6
01/01/2010 to 12/31/2010	1571	1153	275	878	420	111	182	165
01/01/2009 to 12/31/2009	1835	1488	231	1257	600	133	290	234
01/01/2008 to 12/31/2008	1577	1239	233	1006	486	113	201	206
01/01/2007 to 12/31/2007	1491	1138	240	898	455	113	181	149
01/01/2006 to 12/31/2006	1507	1182	249	933	506	110	184	133
01/01/2005 to 12/31/2005	1225	930	175	755	348	77	198	132
01/01/2004 to 12/31/2004	1045	787	164	623	287	71	159	106

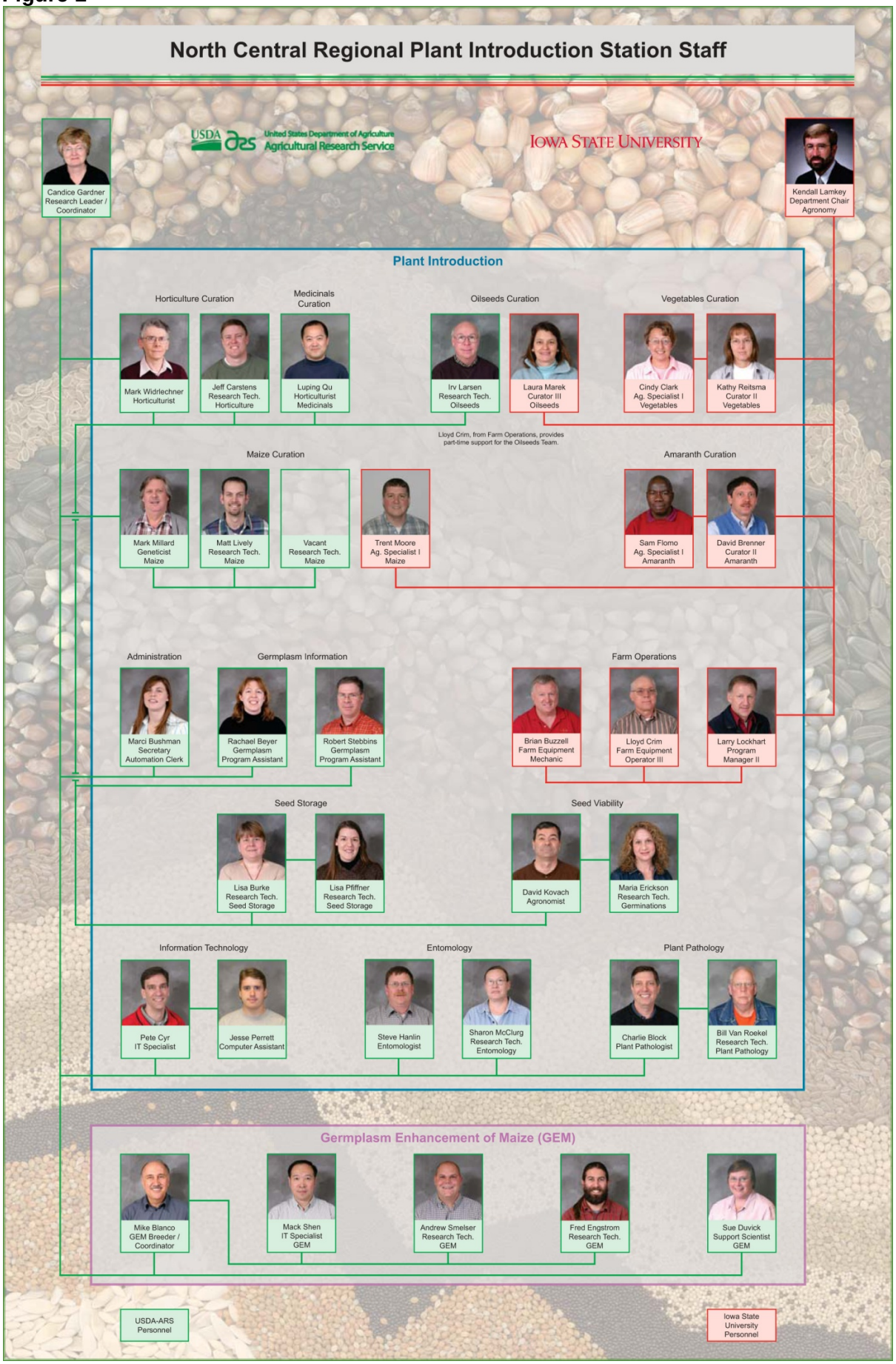
Note: Total Number of Orders includes all orders handled, including NC7 orders.

Table 6b **NC7 NIFA Regional Packet History**

TIME_PERIOD	Total Number of Packets	Number of Packets (DI)	Foreign Packets (DI)	Domestic Packets (DI)	Domestic Packets (in DI orders) NIFA Regions NC7	NE9	S9	W6
01/01/2010 to 12/31/2010	45738	27035	7789	19246	9252	2690	3515	3789
01/01/2009 to 12/31/2009	37564	27359	5931	21428	10917	2587	4096	3828
01/01/2008 to 12/31/2008	40662	24824	6719	18105	9264	1735	3560	3546
01/01/2007 to 12/31/2007	39065	22257	7765	14492	7218	1230	3433	2611
01/01/2006 to 12/31/2006	36382	26079	11950	14129	7483	1550	2354	2742
01/01/2005 to 12/31/2005	34108	22474	7510	14964	4434	2416	4723	3391
01/01/2004 to 12/31/2004	27225	17404	5539	11865	4237	3449	1823	2356

Note: Total Number of Packets includes all packets handled, including NC7 distributed.

Figure 1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Luping Qu Horticulturist Medicinals
Oilseeds Curation
Irv Larsen Research Tech. Oilseeds
Laura Marek Curator III Oilseeds
Vegetables Curation
Cindy Clark Ag. Specialist I Vegetables
Kathy Reitsma Curator II Vegetables
Lloyd Crim, from Farm Operations, provides part-time support for the Oilseeds Team.
Maize Curation
Mark Millard Geneticist Maize
Matt Lively Research Tech. Maize
Vacant Research Tech. Maize
Trent Moore Ag. Specialist I Maize
Amaranth Curation
Sam Flomo Ag. Specialist I Amaranth
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Germplasm Information
Rachael Beyer Germplasm Program Assistant
Robert Stebbins Germplasm Program Assistant
Farm Operations
Brian Buzzell Farm Equipment Mechanic
Lloyd Crim Farm Equipment Operator III
Larry Lockhart Program Manager II
Seed Storage
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